WORLD'S LARGEST GIANT URANIUM DEPOSIT IN NEW MEXICO?

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PREFACE

This short report is the original letter sent to the Editors of American Scientist as coments on the paper - "The Hunt for Giant Uranium Deposits" by E. S. Cheney published in the American Scientist, v. 69, no. 1, p. 39-48, January-February 1981. Because of space limiations this original letter was shortened about one-quarter of its original length by the Editors and published along with Cheney's reply under Letters to the Editors, "Uranium Deposits" in the American Scientist, v. 70, no. 1, p. 12-13, January-February 1982. This report is a more complete critique of Cheney's paper and contains documentation of hitherto unpublished grade-tonnage relations of uranium deposits as well as a discussion on problems of defining a uranium deposit. To our knowledge Cheny's published reply to our letter is essentially that sent to the Editors, so that no further material is available and open-filing this note completes the sequence of correspondence.

THE LETTER

To the Editors:

Eric S. Cheney's point about the significance of "giant" uranium deposits with regard to total resources is well taken in his article "The Hunt for Giant Uranium deposits" (Am. Sci. 69:37-48, January-February, 1981). However, we contend that he is in error on the number of "giant" sandstone uranium deposits in the United States, the number of foreign non-sandstone deposits that fall into his "giant deposit" as one containing $\geq$45,000 metric tons (t) of U_3O_8, and his conclusion that only one deposit in the United States, at Mt. Taylor in New Mexico, barely qualified as a "giant deposit."

We believe that Cheney has underestimated the size of sandstone uranium deposits, but first we must confront the vexing problem of defining a deposit. The "giant deposits" in pre-Paleozoic metasedimentary rocks that are referred to by Cheney are commonly comprised of a cluster of smaller "deposits" (Key Lake, Cluff Lake, Ranger, Jabiluka). Therefore, in the context of Cheney's usage of the term we might define a deposit in an engineering sense as a cluster of ore shoots or pods that are sufficiently close together to be mined by one open pit, or by interconnecting underground workings. In the geologic sense, moreover, a deposit is a variably mineralized zone, not necessarily all economically mineable, that was formed by one process or a series of similar processes, as along one vein, solution interface, or roll front.

The size distribution of sandstone uranium deposits in the United states is not well documented in the literature. In contrast to the situation in Canada, Australia, and elsewhere, land in the major sandstone mining districts in the United States is split up into many small (commonly 1 square mile and even less) tracts controlled by different mining companies. It is erroneous to regard the ore in each tract as a separate deposit because the ore commonly extends into adjacent tracts, and even across several tracts, sometimes for a distance of several miles along a trend direction as in the case of the many New Mexico and Wyoming deposits.

In the main trend of the Ambrosia Lake - Mt. Taylor districts of the Grants mineral belt, individual ore shoots are clustered to the degree that had they been covered by only a few hundred feet of overlying rock, they conceivably could have been mined as one deposit by one open pit that would have been some 16 miles long (Geologic map of Grants uranium region, Sheet 2, New Mexico Bureau Mines and Mineral Resources, 1977). Indeed, the mines in the western half of the trend are now almost all interconnected by underground workings. The eastern half is less-well explored and is still in the early stages of mine development, but it appears that the continuity of ore shoots there will be similar to that in the western half. Low-grade material, commonly present between mineable ore bodies, supports the geologic evidence of a single geochemical event that caused the localization of ore along the entire trend. Reserves in the U.S. Department of Energy's, $30 per pound U_3O_8 forward-cost category plus production for the entire trend is 185,000 t U_3O_8 in rock averaging 0.18 percent U_3O_8. Some additions to the reserves are expected. Production through 1980 was 69,500 t U_3O_8 in rock averaging 0.19 percent U_3O_8--almost all from the western half of the trend.

The size distribution of sandstone uranium deposits approximates the size distribution of deposits in other environments. The Ambrosia - Mt. Taylor deposit is nearly as large as Jabiluka in size (203,800 t contained U_3O_8) and, at a lower cutoff grade, could exceed Jabiluka. Grade-tonnage relationships based on a statistical analysis of the Ambrosia district indicate that at an 0.01 percent U_3O_8 cutoff grade the Ambrosia-Mt. Taylor deposit contains 370,000 t U_3O_8 at an average grade of 0.06 percent U_3O_8. At an average grade of 0.10% U_3O_8, comparable to the average grade at Elliot Lake, it contains 296,000 t U_3O_8. Thus, the Ambrosia-Mt. Taylor may be the largest "giant deposit".

Although the Ambrosia-Mt. Taylor trend is by far the largest in the Grants mineral belt, there are two other clusters of orebodies that exceed Cheney's threshhold value of 45,000 t U_3O_8. Some others that are less well-explored show promise of exceeding this amount.

A second deposit east of Mt. Taylor that qualifies as a "giant" includes clusters of orebodies in the Jackpile and in the Paquate Mines, although the two have been separated by removal of a portion of the deposit by erosion. Production from the Jackpile-Paquate deposit totaled more than 36,000 t U_3O_8 by 1978 (Robert Sisselman, 1978, Engineering Mining Journal, p. 62-69), and reserves remaining in 1978 plus ore estimated to have been removed by erosion would increase the size to at least 75,000 t U_3O_8.

A third sandstone uranium deposit in the Grants mineral belt that qualifies as a "giant" is formed by the Church Rock group of orebodies near Gallup, New Mexico, in the western part of the belt where reserves exceed 45,000 t U_3O_8. The Church Rock group is separated from the Ambrosia-Mt. Taylor deposit by a wide thoroughly oxidized area where much ore may have been destroyed by the oxidation. Thus it is conceivable that a single deposit connecting the two areas may have once existed.

A fourth candidate may be the Nose Rock deposit near Crownpoint which has not been fully explored. Its present reserves have been reported at about 11,000 t U_3O_8 (Phillips Petroleum Co. news release, 12-16-75).

In the Tertiary basins of Wyoming, roll type deposits along the margins of oxidized tongues in sandstone in the Gas Hills, Crooks Gap-Great Divide Basin, Shirley Basin, and Powder River Basin areas, extend for a distance of many miles. Curry (Curry, D. L., 1976, Evaluation of Uranium Resources in the Powder River Basin, Wyoming: Wyoming Geological Association, 28th Field Conference Guidebook, p. 235-242) reports that an area of multiple oxidized tongues in sandstone in the Powder River Basin is about 80 miles long and 5 to 20 miles wide. Economic deposits distributed along the margins of the tongues are connected by nearly continuous mineralization in the 0.01 percent-0.05 percent U_3O_8 range. The ENQ deposit at the edge of an oxidized tongue in the Great Divide Basin has a known length of 5 mi, widths of mineralized sandstone ranging from 100 to 1,600, and thicknesses as much as 30 to 40 feet (Sherborne, J. E., Jr., Pavlak, S. J., Peterson, G. H., Buckovic, W. A., 1980, Uranium Deposits of the Sweetwater Mine area, Great Divide Basin, Wyoming, in Third Annual Uranium Seminar: New York, American Institute of Mining, Metallurgy, and Petroleum Engineers, p. 27-37). In this deposit a halo of low-grade mineralization 20 to 1,000 feet wide extends outward from the higher grade roll-type ore. In the Central Gas Hills district, production plus reserves are about 49,000 t U_3O_8. Other basins in Wyoming probably contain clusters of economic deposits with connecting lower grade material aggregating more than 45,000 t U_3O_8.

Cheney seems to conclude that all "Athabasca" and "Jabiluka" types, generally considered as a single type called "unconformity-related", are "giants." Available information on these deposits indicate a wide range in size from very small to "giants", and that their size distribution may not differ greatly from that of sandstone and other types of deposits. For example, Needham and Roarty (1980, Uranium in the Pine Creek Geosyncline Symposium Proceedings, p. 164) tabulated the contained U_3O_8 for eight Australian deposits; two are >100,000 t U_3O_8, one is in the 10,000-100,000 t class, three in the 1,000-10,000 t class, one in 100-1,000 t class, and one in 10-100 t class; only two of these are "giants." A similar distribution probably exists in Canadian deposits, except none are >100,000 mt. Thus, exploration for the unconformity-vein deposits, per se, does not ensure finding "giants" any more than would exploration for sandstone uranium deposits.

In conclusion, in the U.S. there are several "giant" sandstone deposits, and one of these, Ambrosia-Mt. Taylor appears to be the world's largest "giant".

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