New Mexico GEOLOGY

February, 2017
Volume 39, Number 1

New Mexico Bureau of Geology and Mineral Resources/A Division of New Mexico Tech

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Church Rock #1 East shaft, Church Rock-Crownpoint subdistrict, McKinley County. The mine was operated by Kerr-McKee from 1979 to 1983. Photo by O. Anderson on 3/7/79.

A publication of the
New Mexico Bureau of Geology and Mineral Resources,
a division of the New Mexico Institute of Mining and Technology

Science and Service
ISSN 0196-948X

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Editorial Matter: Articles submitted for publication should be in the editor's hands a minimum of five (5) months before date of publication (February, May, August, or November) and should be no longer than 40 typewritten, double-spaced pages. All scientific papers will be reviewed by at least two people in the appropriate field of study. Address inquiries to Bruce Allen, Geologic Editor, New Mexico Bureau of Geology and Mineral Resources, 2808 Central Avenue SE, Albuquerque, NM 87106-2245, phone (505) 366-2531.

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Uranium in New Mexico: A Special Issue of New Mexico Geology

Virginia T. McLemore and Ted Wilton

In January 2016, a team of experts from the uranium industry and researchers from two New Mexico universities assembled at the Sevilleta National Wildlife Refuge for a three-day workshop to discuss topics associated with in situ recovery (ISR) of uranium. Part of the motivation for this workshop was the recognition that there has been little new research completed by the uranium industry or the academic community, and that much of the current uranium knowledge base consists of research, mapping and technology from the 1970s and 1980s. Researchers and industry workers today have many new technologies available to help re-evaluate exploration, mining, processing, reclamation and restoration. Furthermore, today's industry has become much more open to sharing data, in part because the strenuous permitting process has turned previously proprietary information into public record. Outcomes of the January workshop include two special editions of New Mexico Geology, including this Spring, 2017 issue. The first special issue of New Mexico Geology on uranium (v. 38, no. 4) was published in November 2016 with two articles. We hope that these editions of New Mexico Geology will provide information about current uranium-mining topics.

Another outcome of the workshop was a compilation of a list of research activities that could support renewed activity in the New Mexico uranium industry. Topics include workforce training, resource characterization, hydrogeological and geochemical modeling, updated environmental and regulatory protections, improved understanding of depositional mineralogy, microbiology and geochemistry, and the development of new recovery and restoration technology. In comparison with conventional open pit and underground mining and conventional milling, ISR exploitation of uranium deposits may provide some decided advantages to the environment, including much smaller and shorter duration of land-surface disturbances, allowing the return of the surface to traditional land uses, potentially significant reductions of the introduction of radionuclides into the surface environment, and other reduced impacts to local ecosystems. In evaluating the possibilities of developing an ISR mine it is important to recognize that the portion of the aquifer in which the uranium deposit is situated does not, because of natural conditions, meet national drinking water standards; in other words it is naturally contaminated and it is not suitable for human consumption.

Nonetheless, it is essential that all proposed ISR operations undergo rigorous and detailed pre-mining aquifer characterization studies, careful and detailed mineralogical and geochemical studies of the uranium mineralized zones, and comprehensive modeling of the entire hydrologic regime that is based on physical testing and subsequent modeling. Of particular importance:

- Mobilization of uranium is part of a broader geochemical process that also mobilizes other elements such as molybdenum and radium, and operational procedures are required to stabilize these constituents during ISR mining and after completion of operations (post-closure).
- The geochemical characteristics of naturally-occurring groundwater that oxidized and remobilized and redeposited "trend-type" uranium deposits in the Grants Mineral Belt.
- Updated studies on the various uranium minerals in sandstone-hosted deposits as they impact the potential recovery of uranium metal from these deposits.
- Study of clay species in the mineralized zones, and their impacts not only on porosity and permeability characteristics during uranium extraction, but their geochemical interactions with various elements and compounds during and after groundwater restoration (post-closure).
- Development of detailed hydrological models of the aquifer, relying not only on the results of rigorous aquifer tests, but also a thorough analysis of a detailed geologic model that incorporates all data, at a detailed mine scale, relating to faults, fractures and joints that could otherwise impact the management of the fluids that are used during ISR mining.
- Proper disposal of ISR fluids used during mining.
- Thorough and honest communication with the public and regulators.

While the environmental, technological and operational applications of ISR mining of uranium have advanced appreciably since the time of ISR pilot test programs in New Mexico, these important environmental issues continue to require the attention of mine operators and regulators alike.

Virginia McLemore and Bonnie Frey volunteered to co-chair a keynote session on uranium for the April 7, 2017 spring meeting of the New Mexico Geological Society (NMGS). We hope that interested readers of these articles will join us in Socorro.