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U.S. Geological Survey National Produced Waters Geochemical Database: Identifying brine critical mineral resource potential in oil and gas basins

ANDREW L. MASTERSON, ELI K. MOORE, KATHERINE J KNIERIM, JEREMY K RAY, COLIN A DOOLAN, BONNIE MCDEVITT, AMANDA S HERZBERG, JESSICA CHENAULT AND AARON M JUBB

U.S. Geological Survey

Produced waters, water co-produced during oil and gas recovery, are the largest waste stream associated with the petroleum industry in the United States, comprising ~10^{12} gallons per year. The chemical and isotope compositions of these produced waters provide valuable scientific information on subsurface fluid sources, extent of water-rock interaction, and the potential for fingerprinting brines at regional and sedimentary basin scales. Recently, produced waters have been recognized by industry for their critical mineral commodity potential (e.g., lithium), which can be present in produced water at concentrations sufficient for economic recovery and may represent an important domestic source of critical mineral commodities in the future.

To provide information on the geochemistry and physical properties of produced waters, the U.S. Geological Survey maintains the National Produced Waters Geochemical Database (NPWGD), with the latest version (v. 3.0) released in December 2023. This most recent version compiles data from 110,000 produced water samples from >58,000 wells detailed in published reports dating to the 1950s. The database includes more than 210 geochemical, physical, and isotopic properties, as well as location information and well metadata, where available. The majority of samples contain crucial information including total dissolved solids and dissolved major cations and anions; however, many included data sets contain only select geochemical criteria.

The NPWGD has been used by industry, academic, and government stakeholders in estimating brine critical mineral resource potential in a number of oil and gas basins, such as the Gulf Coast, Appalachian and Williston Basins. It has significant value in providing inputs for machine learning models generating regional estimates of mappable, in-place brine-hosted critical mineral resources. Additionally, there is significant opportunity for the NPWGD to be applied in estimating commodity co-recovery potential. Recent updates to the NPWGD viewer, including migration to an Esri ArcGIS-hosted platform that adds interactive features, improves speed and usability, and provides for the rapid selection of geochemical data by basin and formation.