

Abstract

As a clean, efficient, and multi-purpose energy source, hydrogen energy has become an important direction for energy transformation. Deep bedded salt rock hydrogen storage utilizes the bedded structure of underground salt rock as a storage medium and injects hydrogen into the salt rock layer for storage. However, the sealing mechanism of hydrogen storage in deep bedded salt rock requires further investigation to ensure long-term, stable, and efficient operation. Physicochemical interactions between hydrogen, salt rock, and interlayer rock, along with damage to the surrounding rocks and wellbore due to various factors, pose challenges to effectively controlling hydrogen storage sealing. This project will focus on the key problems of hydrogen storage sealing in deep bedded salt rocks, clarify the physicochemical mechanism of hydrogen interaction with salt rocks and interbedded rocks, reveal the damage mechanism of the surrounding rocks of hydrogen storage under multi-field coupling conditions, establish a method to evaluate the sealing of wellbore under the combined effect of alternating load and corrosion, and develop the key technology of hydrogen storage sealing control in deep bedded salt rocks. Through the research of the above-mentioned key fundamental issues and achieving original breakthroughs, it will provide the key theoretical basis and scientific basis for the deep bedded salt rock hydrogen storage technology, not only in Poland but in other parts of the world. The project aligns with international priorities in the energy transition, where hydrogen plays a key role in decarbonizing energy systems. Its outcomes will directly support the development of safe, efficient, and scalable hydrogen storage technologies essential for achieving net-zero targets.