The Corning Mine Complex as a possible heat exchanger for heat pump applications

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Waters within flooded abandoned underground mines (AUM) can be used as heat exchangers in geothermal heat pump (GHP) applications for space heating and cooling. The utilization of the waters within AUMs are potentially advantageous compared to conventional heat pump systems, which exchange heat with the atmosphere, and traditional GHP installations, which exchange heat with either saturated or unsaturated soils and bedrock. Due to the legacy of room and pillar coal mining in Ohio, the exploitation waters within AUMs with GHPs could be a valuable heating and cooling resource for this state.

To better understand the mechanisms for heat transfer between the atmosphere and the waters within flooded coal mines in Ohio, the Corning Mine Complex located in Perry County, Ohio, was evaluated for thermal response to atmospheric and hydrologic changes throughout the year. Temperature and hydraulic head sensors were installed within monitoring wells, and time series analysis was performed on the collected data, to track and quantify changes in mine temperature with respect to precipitation, atmospheric temperature, and water levels within the mine complex. The amount of theoretical heat extractable using a GHP installation, volume of water within the mine complex, and subsequent residence time of water within the mine complex were calculated based upon the water levels within the monitoring wells.

The results of this study suggest that waters within the mine complex are thermally stable throughout the year and vary locally with overburden thickness with higher temperatures when the overburden is thicker. The temperatures within the monitoring wells did not vary with precipitation events, except for wells which were either damaged or otherwise compromised. Our results show that the amount of heat extractable from the mine void is 3.12×10^{10} kJ/^{o}C. The localized thermal stability within the mine void and the relative quick response returning to stable temperature from damaged wells, suggest a high capacity for the mine complex to be used for GHP geothermal energy. Overall, this work suggests that AUMs could be a valuable resource for geothermal energy within Ohio.