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Editorial: Interactions between groundwater and human communities: perspectives on the resources, environments, threats and sustainable development

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Editorial on the Research Topic
Interactions between groundwater and human communities: perspectives on the resources, environments, threats and sustainable development

Groundwater is essential for human societal development, eco-environment protection and maintenance, surface and underground geological processes, and substance circulation among Earth's geospheres (i.e., hydrosphere, lithosphere, and biosphere) (Xiao et al., 2022b; Yang et al., 2023). With the rapid increase of human demand and the enhancement of technical procedures, human activities that affect the hydrosphere have expanded from near the surface (along rivers or surrounding lakes) to much wider regions over the past thousands of years (Luo et al., 2021; Stigter et al., 2023). This will inevitably intensify external disturbances on groundwater systems and their hydrogeological processes, which may destroy the functions and values of groundwater for nature and human communities and induce/aggravate water-related geological disasters (Xiao et al., 2022c; Qu et al., 2022). Deeply understanding interactions between groundwater systems and human societies is vital to achieve sustainable groundwater exploitation, protecting groundwater-dependent eco-environmental systems and controlling geohazard emergence.

Over recent decades, the diversity of interactions between human societies and groundwater systems has been unprecedented (Mádl-Szőnyi et al., 2023). Aquifers disturbed by intense human activities, such as the sedimentary aquifers in the North China Plain and arid north-western China, have experienced severe groundwater supply crises (e.g., depletion and deterioration), which, in turn, affects human communities and ecological environments (Qiu, 2010; Xiao et al., 2022a). Additionally, more and more groundwater-related challenges are being encountered by human communities (Li et al., 2019). Significant new knowledge, management experiences, and their disseminations can be

expected to inform understanding of relationships among groundwater, eco-environmental systems, and human societal development.

In this context, this Research Topic encouraged the academic community to contribute original outputs for sustainable groundwater development from the perspectives of water quantity, quality, and eco-environmental aspects. A total of 17 articles were collected on the interactions between groundwater and human communities. Several articles reported the water chemical status on the surface and subsurface water body in various land use areas, such as agricultural, industrial, and urban lands, and mining areas, and concluded that human activities have already widely influenced and even changed the hydrochemical features of natural water bodies distributed in and around the human community regions. Integrated approaches that include the combination of the self-organizing map and entropy-based weight determining method, *etc.*, were proposed and tried to improve the accuracy of water quality assessment. Sediment investigation and groundwater hydrochemical and isotopic tools were combined in an article to better illustrate the flow rate, renewable capability, residence time, and hydrochemical availability of groundwater in alluvial fan plains. Several articles discussed the influencing mechanisms of human activities, such as urbanization, agricultural activities, mining practices, and drainages, on groundwater circulation and hydrochemistry. Three researches explored the transport, transfer, and influencing factors of pollutants into water bodies from the micro-scale perspective. An *in situ* remediation technology, namely, the permeable reactive barrier, was improved and evaluated in terms of reaction materials for better removing heavy metal pollutants in groundwater.

In addition to the availability of groundwater quantity and quality, the secondary geological disasters related to water were reported in this Research Topic. Guo et al. combined theoretical model analysis, geotechnical tests, soil deformation, and groundwater level monitoring to get insights into the mechanism and related affecting factors of land subsidence and pointed out that the huge pumping groundwater quantity for agricultural irrigation is responsible for the land subsidence in the North China Plain. Liu et al. studied the behavior of deep clayey soil during the compression and consolidation process, and revealed the occurring mechanism of land subsidence from a micro perspective after great groundwater pumping. Gao et al. examined the role of various factors including geological conditions, earthquakes, and water for landslide occurrence in mountainous regions and indicated groundwater quantity induced into the slide body by rainfall plays an essential role in the occurrence of landslides.

In addition, some scholars explored the ways to improve the simulation and understanding of groundwater in special hydrogeological conditions. For example, Zhou et al. tried to modify the source code of SWAT to realize the simulation of sinkholes in karst groundwater modeling. Wu et al. discussed the impact of a horizontal low-k layer within a homogeneous aquifer on saltwater up-coning using the numerical approach and provided a simple tool for developing natural and artificial barriers to prevent saltwater up-coning in coastal areas and enhance the pumping efficiency. Furthermore, an article by Li et al. constructed index systems for evaluating the dynamic relationship between water resources and new urbanization, and proposed useful suggestions for coordinating the development of water resources and urbanization.

The articles collected in this Research Topic will undoubtedly improve the understanding of interactions between human communities and the hydrosphere, especially the underground hydrosphere, for the academic community from various aspects. We hope and believe this Research Topic could inspire further research in hydrology earth science and benefit the sustainable development of Earth's hydrosphere and the human community.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Publisher's note

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