沿海含水層的溫度分布:來自地下水模型及現地數據的見解

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摘要

沿海含水層溫度分布受不同熱源影響，像是:地表水補給、海水入滲、地熱。以往的研究中，通常將各項熱源所產生的信號單獨考慮，且忽略地熱所帶來的影響。本次研究首次藉由結合現場數據及數值模擬提出一個同時考慮沿海含水層中所有可能熱源且基於真實含水層特徵的參考模型。本研究在考慮變密度流、耦合熱及溶質傳輸情況下建立模型，找出淡水-海水交界面(FSI)以及其對沿海含水層溫度分布的影響。本研究在水力及熱參數的敏感性分析基礎上，擴大沿海含水層溫度分布的理論知識。此外，為測試本模型對真實含水層的適用性，對研究案例(Motril-Salobre˜na aquifer)進行建立模型及現場數據校正。本研究提供了沿海地區溫度分布的新見解，並為今後在沿海含水層中使用熱作為示蹤劑的相關研究奠定基礎。

關鍵字: 熱傳輸、數值模擬、地溫梯度、海水入侵、溫度波動

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Research papers

Temperature distribution in coastal aquifers: Insights from groundwater modeling and field data

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ABSTRACT

The temperature distribution in coastal aquifers is determined by the effect of different heat sources: surface water recharge, sea infiltration, and geothermal heat. In previous studies, the signal generated in groundwater by each source was individually studied, and in the case of geothermal heat, it was often not considered. This research is the first in considering all possible sources of heat in a coastal aquifer simultaneously by using a combination of field data and numerical modeling to present a reference model based on the characteristics of a real aquifer. The position of the freshwater-saltwater interface (FSI) and its effect on temperature distribution have been modeled considering variable-density flow, coupled heat and solute transport. This study broadens the theoretical knowledge of temperature distribution in coastal aquifers based on a sensitivity analysis of hydraulic and thermic parameters. Furthermore, a case study (the Motril-Salobreña aquifer) was modeled with field data calibration to test the applicability to real aquifers. The new insights gained through this study provide integrated knowledge of the temperature distribution in coastal areas and establish the basis for future research using heat as a tracer in seaside aquifers.