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Chemical clogging of confined aquifer induced by dewatering well: a quantitative assessment for exploitation management

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Wells productivity during water exploitation from confined and unconfined aquifers often decreases with time due to several interdependant physical and chemical phenomenon. The most common reason to explain productivity variations involves a reduction of aquifer permeability by chemical scaling in the well screen and into the formation materials around the intake portion of the well. Many field data have demonstrated that unsuitable pumping scheme of confined formations involves repeated dewatering of aquifer in the vicinity of the production well, inducing major changes in the chemical composition and equilibrium of water within the aquifer. This study focuses on the complex relationships between dewatering and chemical clogging in order to quantify long-term evolution of aquifer porosity and well productivity.A synthetic confined carbonated aquifer was subjected to successive dewatering induced by a single pumping well. We developed a global coupled model in order to understand and quantify the relative importance of the main parameters involving chemical scaling. Groundwater flow around the well and the variation of dewatering area and volume with time are computed using the well-known finite-difference model MODFLOW. This step is then followed by a second one, based on the geochemical model PHREEQC, which describes the chemical variations of the mining water induced by its exposure to new gas phases (O_2, CO_2, N_2 ...). Thus it is possible to determine the predominant scaling induced by dewatering and the respective precipitated amounts. The last step of the modelling concerns the evolution of the hydraulic properties into the dewatered area of aquifer due to chemical deposits and the evolution of well productivity.This study highlights the importance of dewatering frequency on chemical

clogging of the aquifer and particularly the role played by carbonate compounds in porosity variations. As example a long-term transient simulation of 20 years is done showing a great productivity loss similar to existing field data and observations.Even it is limited to chemical clogging, this coupled approach is a first step to a quantitative understanding of the large issue of exploitation well ageing.