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Preliminary Analysis of Groundwater Quality Affected by Dissolution of Heavy-Metal-Bearing Minerals due to CO_2 Leakage from Geological Storage

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Abstract. Geological storage of CO_2 is under intensive investigation. The potential for leakage from CO_2 storage reservoirs and its impact on groundwater quality in potable aquifers is a significant concern. CO_2 dissolution in groundwater decreases pH, the increased acidity can affect the solubility of minerals containing such heavy-metals as Pb, As, Hg, Sb, Se, Cu, Ni, Co, Zn, Cd, Mo, and U, and cause their concentration to increase in the potable water. Dissolution of some heavy metals could be further enhanced through carbonate complexation, possibly exceeding EPA specified health based limits for drinking water. However, heavy metals also adsorb onto mineral surfaces of the aquifer, limiting the maximum concentration in solution. Furthermore, subsequent degassing of the dissolved CO_2 during recovery, with precipitation of secondary carbonates (and hydroxy-carbonates) could cause the co-precipitation of some heavy metals (such as Pb(II)). Because many hydrogeological and geochemical factors can affect the dissolution and precipitation behavior of heavy metals, their mobilization can be best studied using a reactive geochemical transport modeling. A number of simulations using the program TOUGHREACT were performed under elevated CO_2 pressure conditions. Using Pb(II) as an example, results and sensitivities are discussed.