Laboratory and Numerical Simulation of the Accelerated Erosion Model for Arsenic Contamination of Groundwater

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Abstract. According to the accelerated erosion model, arsenic contamination of groundwater in south Asia results from a combination of monsoon climate, tectonic uplift, deforestation, and overgrazing. The consequence of the accelerated erosion is elevated arsenic in rapid mountain streams, resulting in elevated arsenic in the losing valley rivers that recharge groundwater. The elevated arsenic in rapid mountain streams results from the inability of the large, multivalent arsensate oxyanion to adsorb onto sediment in rapid flow conditions for two reasons. First, sediment tends to have many fewer positively-charged than negatively-charged sorption sites. Second, the sorption sites must be sufficiently widely-spaced to accommodate the large arsenate oxyanion. As a consequence, the arsenate oxyanion cannot attach to multiple positively-charged sorption sites unless it has sufficient residence time in the vicinity of the sorption sites for all necessary sites to become simultaneously vacant. A competing factor is that a rapidly-moving arsenate oxyanion will encounter a greater number of possible sorption sites. The objectives of this study are (1) to use a modified Armfield Hydraulics Bench to develop a quantitative relationship among degree of arsenate sorption, flow rate and sediment anion exchange capacity (2) to carry out a numerical simulation of the effect of flow rate on sorption. Preliminary results show that sorption is favored by high flow rate when anion exchange capacity is low and low flow rate when anion exchange capacity is high, which is consistent with the above competing factors. Further results will be reported at the meeting.