Depression-focussed recharge in the prairies of Alberta: Insights from stable isotope data

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ABSTRACT
Large numbers of rural communities and individual households in the prairie region of Alberta depend on groundwater extraction to meet their needs. However, uncertainty persists regarding the contribution of different pathways to the groundwater recharge in the area. Previous studies in this region showed using isotopic techniques that as much as half of shallow groundwater is sourced from snowmelt. As only a small fraction of annual precipitation comes in winter, the strong role of snow-derived water in recharge is believed to be the consequence of ponding of numerous small depressions abundant in this part of Alberta. These findings prompt the question of whether recharge not derived from snow also occurs through depression ponding or through other mechanisms. The goals of this study are to evaluate a possible role of spatially distributed (diffuse) recharge, as well as to confirm an existence of the link between the high fraction of snow-derived groundwater and depression-focussed recharge. Field studies were conducted at three study sites in the fringe of the prairies close to its transition into boreal forest. At each site a depression catchment was chosen, where two alternative recharge pathways were identified: depression-focussed and diffuse recharge. All media along alternative recharge pathways were sampled including snow, snowmelt runoff, water ponded in depressions, vadose-zone water and groundwater. The samples were analysed to infer the signatures of stable isotopes of water associated with different recharge pathways. The results were compared with isotopic composition of water samples from a number of domestic wells in the areas surrounding the study sites. The isotopic signature of diffuse recharge differed from one of depression-focussed recharge, allowing for separation of the two recharge components. The isotope data also indicated that groundwater in a number of domestic wells had even higher snowmelt-derived fraction than thought previously.

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