A Quantitative Assessment of the Presence and Mobility of Trace Metals in Soils and Groundwater

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Intensive agricultural practices have loaded salts, nutrients and trace metals onto soils and underlying groundwater in aridlands. We used a box model approach and assessed the retention and mobility of trace metals in a pecan orchard near El Paso, Texas. Here in the semi-arid region of the southwestern United States, Rio Grande river water, along with groundwater, is used for flood irrigation, and soil amendments are added as fertilizers and pesticides. Cultivation in the region is limited to the Rio Grande valley and soils are developed on fluvial sediments deposited by ancient and modern Rio Grande. These soils thus have heterogeneous texture within the orchard, and also with depth, controlling water infiltration, water residence time, salt buildup and connection of soils with underlying aquifer. Soil samples were collected from two sites of contrasting texture, and characterized for trace metal retention using a sequential extraction method, water-soluble fraction, exchangeable faction, and pedogenic carbonates. In addition, irrigation water, soil water, groundwater samples, as well as liquid and solid soil amendments were collected over several irrigation events to quantify the loading of trace metals onto these agricultural soils and examine their mobility within shallow soils and movement to groundwaters. Preliminary data clearly identified high inputs of soluble As, V, Zn etc in irrigation water and soil amendments, and these metals co-precipitated out in soils, with evaporite salts and pedogenic carbonates, but most remained mobilized and recharged to groundwaters. This analysis of trace metals using a mass-balance approach allows us to observe the current quality of soils used for agriculture followed by the mobilization of trace metals in the aqueous phase that can be taken up by crops or dispersed over underlying groundwaters that pose a threat to human health.