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Cotransport of Iron Oxides with Different Sized-Plastic Particles in Saturated Quartz Sand

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The present study was designed to investigate the cotransport of different-sized plastic particle from nanoscale (0.02 μm) to micrometer-scale (0.2 and 2 μm) with goethite and hematite (two types of most abundant iron oxides) in porous media at both low (5 mM) and high ionic strength (25 mM) in NaCl solutions. The results showed that under all examined solution conditions, the presence of smaller plastic particles (0.02 and 0.2 μm) increased the transport of two types of iron oxides, while the presence of large plastic particles (2 μm) did not increase the transport and deposition of iron oxides. In contrast, the presence of either goethite or hematite did not change the transport and deposition of smallest plastic particles (0.02 μm), while the transport of larger plastic particles (0.2 and 2 μm) in quartz sand was decreased by the copresence of iron oxides. The mechanisms controlling the cotransport of iron oxides and plastic particles were then systematically determined. The interaction of 0.02 μm nanoplastics with iron oxides, the deposition site competition, and the steric repulsion induced by suspended 0.02 μm nanoplastics were found to drive to the enhanced transport of iron oxides with copresent of 0.02 μm plastic particles, while the adsorption of 0.2 μm plastic particles onto iron oxides was major contributor to the increased transport of iron oxides with the copresence of 0.2 μm microplastic particles. As for the decreased transport of 0.2 μm and 2 μm microplastics by the copresence of iron oxides, we found that the cotransport of plastic particles with iron oxides due to the adsorption onto the surfaces of iron oxides was the major contributor to the decreased the transport of 0.2 μm microplastic particles, while, the modification of surface properties due to the adsorption of iron oxides onto surfaces of 2 μm microplastics as well as the additional deposition sites provided by the iron oxides contributed to the decreased transport of 2 μm microplastic particles with copresent of goethite or hematite.