Trace metals in atmospheric particular matters over the northern South China Sea (SCS): regional sources and long-range atmospheric transport

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Abstract

A total of 65 daily aerosol samples were collected in two open cruises covering the whole northern SCS in September 2005 and August 2007, respectively. The concentrations of Cr, Cu, Ni, Zn and Pb in particular matters (PM) of the northern SCS were comparable to the values measured in suburban and background sites of south China. Cu showed relatively high concentrations during the two sampling periods, suggesting the regional sources of Cu pollution in the Pearl River Delta (PRD) area, south China. The calculated enrichment factor (EF) values of Cu, Zn and Pb were generally greater than 10, indicating the strong influences of anthropogenic inputs. As shown by the backward air trajectory analysis, the high concentrations of trace metals in the air during the sampling periods were mainly related to the air mass passing over the neighboring cities or countries around the SCS. Elevated concentrations of Pb and Zn in the daytime of the 2007 summer criuse may indicate the effects of traffic emissions from the nearby cities around the SCS. The relatively high concentrations of trace metals during the northeastern monsoons in 2005 were probably attributed to local emissions and long range atmospheric transport of pollutants by the Asian monsoon.

Fluorescent nanoparticle tracers

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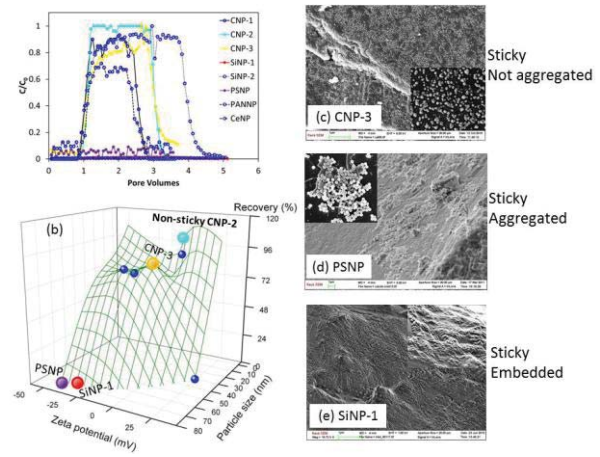
Introduction

Tracers are perhaps the most direct and efficient way of determining subsurface fluid flow pathways. Particle tracers could arrive faster at a detection site because they would not diffuse, as would chemical tracers, from the fractures where flow occurs. Indeed their early arrival could measure the fraction of flow that occurs through the fractures. A requirement is that the particles not aggregate or stick to mineral surfaces. Here we describe our method for screening paticles for stickiness and present results for 8 nanoparticles that suggests small size and neutral charge keep particles from sticking.

We inject a slug of artifical brine that contains nanoparticles into a column filled with crushed calcium carbonate, and follow this slug with particle-free brine. The particle concentration in the effluent is measured by the fluorerscence of the nanoparticles, and the fraction recovered is determined by intgration over time. Results are shown in Figure 1 for 8 nanoparticles: small ethanolamine carbon dot (light blue, CNP-2), large ethanolamine carbon dot (CNP-3), small Jeffamine carbon dot (CNP-1), commercial silica (SiNP-1), silica coated with polyethylene glycol (SiNP-2), polystyrene commerical (PSNP), polyacrylonitril (PANNP), and a



Ce-fluoride (CeNP).

Figure 1. (a) NP concentration (in brine) as a function of injection pore volumes. (b) 3D-countour plot showing particle recovery as a function of particle size and zeta potential. (c-e) SEM images of the CNP-3, PSNP and SiNP-1 particles.

Results and Conclusion

The nanoparticles that showed the least stickiness is the small 3 ± 2 nm ethanolamine carbon dot (CNP-2 light blue on plots) which has zeta potential near zero.