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Stream transport of iron and phosphorus by authigenic nanoparticles in the Southern Piedmont of the U.S.

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1 **Stream Transport of Iron and Phosphorus by Authigenic Nanoparticles**
2 **in the Southern Piedmont of the U.S.**

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7

8 **Abstract**

9 Authigenic nanoparticles containing iron (Fe) and phosphorus (P) have been identified at the
10 anoxic/oxic interface of various aquatic ecosystems, forming upon the oxidation of reduced Fe. Little is
11 known about the prevalence of these authigenic nanoparticles in streams, their impact on biogeochemical
12 fluxes, or the bioavailability of P associated with them. In this paper we used transmission electron
13 microscopy to document the presence of authigenic (amorphous) nanoparticles, rich in Fe and P, in
14 baseflow of streams in the southern Piedmont region of the U.S. We used a simple centrifugation and
15 ultrafiltration technique to separate authigenic nanoparticles from truly dissolved (<1 kDa) and crystalline
16 mineral/coarse organic fractions in baseflow, employing three different quality control methods to verify
17 a successful separation: X-ray diffraction, electron microscopy, and stoichiometry of Fe and aluminum.
18 This allowed us to quantify the amount of Fe and P in three different fractions of baseflow: truly
19 dissolved, authigenic nanoparticles, and crystalline mineral/coarse organic particles. For the rural and
20 urban stream in our study, on average, authigenic nanoparticles in baseflow transport 66% of Fe, with
21 baseflow concentrations ranging from 80 ug/L to 650 ug/L. Authigenic nanoparticles also transport an
22 average of 38% of reactive P, depending upon seasonality and time elapsed since the last storm event.

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24 **Keywords**

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