ENTRAINMENT AND TRANSPORT OF COARSE STREAM BED MATERIAL IN A FLUVIOKARST WATERSHED, SOUTH-CENTRAL MISSOURI: A TRACER PARTICLE STUDY

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ABSTRACT

The midcontinent of the U.S. is karstified and contains well developed subsurface drainage systems covered by beds of coarse-grained, poorly sorted sediments, resembling those in upland surface streams. Within Tumbling Creek Cave (TCC) in the Ozark Plateau of south-central Missouri, and Bear Cave Hollow (BCH), one of TCC's surface drainage streams, bed load entrainment and transport dynamics of mainly siliciclastic material, was evaluated using hydrological measurements and 670 painted tracer particles.

Median surficial sediment grain size in the study reaches ranged from 39 to 71 mm in TCC, and from 24 to 37 mm in BCH with channel slopes ranging from 0.006 to 0.077 in TCC, and from 0.002 to 0.009 in BCH. Preliminary data from surveys of the longitudinal movement of tracers over a 10-month period indicate that minor amounts (0-13.2%) of coarse bed material in TCC are mobilized by relatively low flows (5-28% of bankfull) that recur somewhat frequently (less than 3.1 years). BCH transports a higher percentage of material (0-59.1%) during similar flows (2-29% of bankfull) and frequencies (less than 3.59 years).

The use of the Shields (1936) criteria tends to over predict the critical shear stress required for entrainment of the largest mobilized grain sizes, while the empirical equation of Bagnold (1980) performs much better. Thus, the Shields equation may be better suited as a gage for complete mobilization of a grain size class across a reach, while the Bagnold (1980) equation may be better suited for estimating entrainment of grains from patches of the bed.