STRATEGIES FOR DETERMINING CONTRIBUTIONS FROM GEOLOGIC AND ANTHROPOGENIC SOURCES OF ARSENIC TO INNER COASTAL PLAIN STREAMS IN NEW JERSEY, USA

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ABSTRACT

In New Jersey stream reaches listed as impaired for arsenic, development of a Total Maximum Daily Load rests on the determination of natural or anthropogenic sources of the arsenic. The U.S. Geological Survey designed and implemented sampling strategies to assist the New Jersey Department of Environmental Protection in assessing arsenic sources to streams where levels exceed the health-based New Jersey Surface Water Quality Standard (0.017 micrograms per liter) developed for this carcinogenic substance.

Many of the streams that drain to the Delaware River in New Jersey have headwaters underlain by quartzose sediments of Upper Tertiary age. Lower Tertiary and Late Cretaceous sediments, which contain minerals enriched in arsenic (clays, glauconite), underlie the downstream reaches. The streams flow through agricultural areas where arsenical pesticides might have been used, and through developed areas where urban/industrial arsenic sources could be present.

Several assumptions guided sampling strategies. (1) Chemical "fingerprints"— proportions of arsenic to metals of geologic origin—would be similar among the streams sampled at and downstream from outcrop areas of arsenic-rich geologic formations. (2) Geologic fingerprints could be reflected in the chemistries of ground water discharging to the stream-bed. (3) Synoptic sampling of streamwater and ground water during elevated flow and base flow would help distinguish between arsenic contributed by runoff and arsenic contributed by ground water. (4) Anthropogenic sources likely would produce different chemical fingerprints than would geologic sources and could vary among watersheds. (5) Instream processes affecting the surface-water chemistry could be illuminated by determining chemistries of streamwater, ground water, and bed sediments. Therefore, samples of surface water, ground water below the streambed in gaining reaches, and bed sediments were collected above head-of-tide from three watersheds that contain suburban/urban development, differing types of agriculture, and that are underlain by the same geologic formations. Early results indicate geologic and anthropogenic fingerprints can be discerned.

KEYWORDS

Arsenic, chemical fingerprint, geologic source, anthropogenic source