

Investigation of the Environmental Effects of Proposed and Current Lead Mining in Southern Missouri

Background

Recent prospecting for lead-zinc ore deposits in southern Shannon County, northern Oregon County, and southwestern Carter County in southeast Missouri have raised concerns about potential degradation of surface and ground water resources. Of particular concern is the potential for surface-water and ground-water contamination in the nearby Ozark National Scenic Riverways (ONSR), managed by the U.S. National Park Service, and the Eleven Point Wild and Scenic River, managed by the U.S. Forest Service. Preliminary studies indicate that the area considered for new mining (Prospecting Area) includes the recharge area for Big Spring, an important resource within the ONSR.

In response to concerns about potential effects on federal lands, Congress appropriated funds for a USGS multi-year investigation to evaluate the effects of current and proposed lead mining activities on ground-water levels, water quality, and aquatic biota of the Prospecting Area and currently-mined Viburnum Trend. Biologic, hydrologic, and geologic studies began in 2001 with three primary objectives:

- (1) determine potential effects of mining and related activities on quality and quantity of ground and surface water;
- (2) document existing conditions in the Prospecting Area by collecting and compiling baseline information against which to monitor effects of potential new mining; and
- (3) determine effects of current mining activities in the Viburnum

Trend as an indication of potential impacts of future mining in the Prospecting Area or elsewhere in the Ozarks.

Mining in the Viburnum Trend began in the late 1960s. Relative to other mining districts in Missouri, the mining and environmental practices of the Viburnum Trend use modern technology and conditions are representative of what might occur should mines be developed in the Prospecting Area. Geographically, the USGS studies focus on two areas: the Black River watershed, which drains actively and recently mined portions of the Viburnum Trend (Fig. 1); and the Prospecting Area, which includes parts of the Eleven Point and Current River watersheds (Fig. 2).

The two largest springs in Missouri, Big Spring and Greer Spring, are located near the Prospecting Area (Fig. 2). Big Spring discharges to the Current River within the boundaries of the

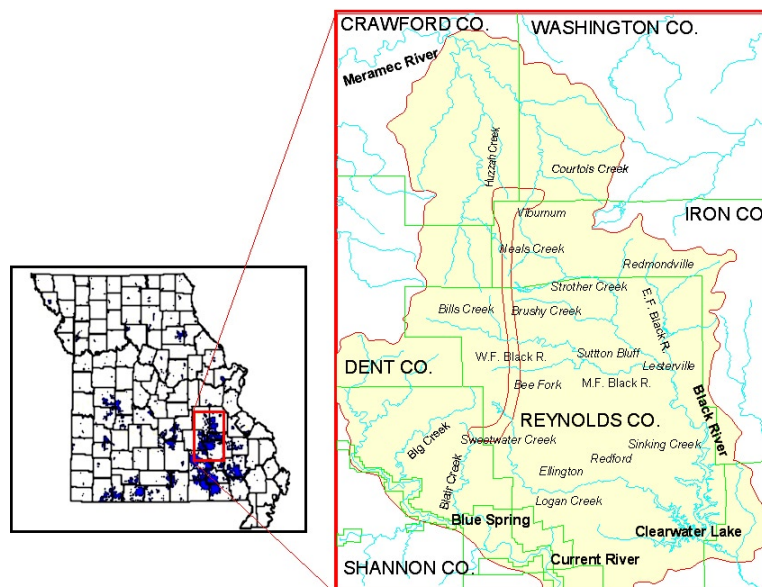
ONSR, and Greer Spring discharges to the Eleven Point River. The USGS investigations will provide information needed by resource managers for evaluating mining proposals relative to these important aquatic resources.

Geologic and Hydrologic Studies to Assess Potential Groundwater Impacts of Mining on Surface and Ground Water

Surface- and ground-water flow in the karst terrain of the Missouri Ozarks is extremely complex and interconnected. Streams can lose water when they encounter fractures, caves, or permeable rock formations, and springs can discharge from solution-enlarged bedding planes and cave systems.

Mining frequently requires pumping large quantities of ground water to dewater mines and disposing of tailings (waste rock) on the surface. Mine dewatering can potentially affect

Figure 1. Viburnum Trend Mining Area. Federal lands (outlined in green), Viburnum Trend (irregularly shaped area in center outlined in red), and Clearwater Lake (lower right).



ground-water flow and tailings piles can affect surface-water quality.

Geologic mapping was done to locate formations, fractures, faults, and other features that may influence ground- and surface-water flow to springs. Hydrologic investigations include dye traces, continual ground-water monitoring along the Viburnum Trend, ground water level measurements of domestic and public water wells, and measurement of rock hydraulic conductivity (rate at which water can move through a rock). These methods are used to characterize ground-water flow in the region and advance the understanding of geologic controls on ground water. From these studies a regional hydrogeologic framework is being developed that will lead to an understanding of ground-water dynamics and be used to evaluate the effects of potential mining in the Prospecting Area.

Documentation of Existing Water Quality and Ecological Conditions in the Prospecting Area

Metal concentrations are generally low in surface and ground waters in the Prospecting Area and are believed to be low in other un-mined areas of the Ozarks. Water, sediment, and biota samples from springs and streams and water samples from wells have been collected in and around the Prospecting Area since 1990. The water and sediment samples were analyzed for common anions and cations as well as trace metals to determine baseline concentrations. This information will be used to characterize the quality of ground and surface water in undisturbed areas, and will be helpful in determining the extent to which mining has impacted other areas within the Ozarks, such as the Viburnum Trend.

Groundwater analyses indicate that concentrations of elements such as lead, arsenic, and cadmium are below toxic thresholds in ground water unaffected by mining. Other investigations confirm that

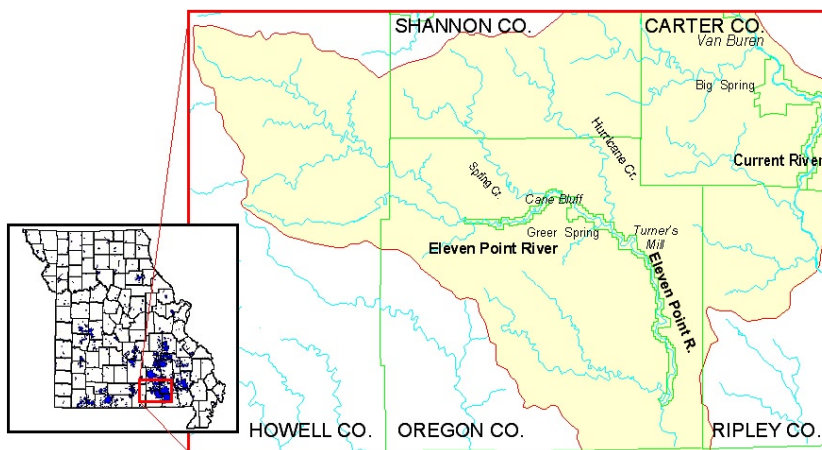


Figure 2. Prospecting Area. Ozark National Scenic Riverways and Eleven Point Wild and Scenic River corridors (outlined in green).

background concentrations of metals in stream sediments and fish from the Prospecting Area are low, about the same as those in streams of the Viburnum Trend that are not affected by mining. Analyses of additional samples are not yet completed, and ecological studies in the Prospecting Area have just begun.

Documentation of Present Water Quality and Ecological Conditions in Waters of the Viburnum Trend

Conditions in the Viburnum Trend, where lead mining has occurred with varying intensity since the 1960s, are important in that they may reflect conditions likely to occur should mining expand into the Prospecting Area. This information will be used to determine if the mining strategies practiced in the Viburnum Trend will be protective of the water resources and aquatic biota within the Prospecting Area.

The geochemistry of rocks and minerals from the two areas are being compared. Drill core samples from both areas were subjected to detailed microscopic and chemical analyses. Findings to date indicate that the relative magnitude of trace metals in rocks and minerals of the two areas are similar.

Sediments from streams draining the Viburnum Trend were analyzed for trace metals. Concentrations at some sites near mines exceeded current sediment quality guidelines for the

protection of aquatic life. Further testing revealed that sediments from two streams near mining areas were toxic to aquatic invertebrates. Ongoing studies are determining the nature of the materials responsible for the toxicity. A related component of the sediment study is a chronological evaluation of sediments accumulated in Clearwater Lake, a storage reservoir located on the Black River downstream of the Viburnum Trend (Fig. 1).

Blood collected from fish in streams draining the Viburnum Trend were also analyzed for metals and for the activity of an enzyme that is reduced by exposure to lead. Results indicate that fish in some streams are exposed to lead and other mining-derived metals. Analyses of metal concentrations in tissues of these fish and other stream organisms are in progress. A study of the aquatic communities of these streams begins in 2003.

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