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Studies of Suction Dredge Gold-Placer Mining Operations Along the Fortymile River, Eastern Alaska

The U.S. Geological Survey (USGS) and the Alaska Department of Natural Resources (AKDNR) are investigating the environmental geochemistry of the Fortymile River drainage area in eastern Alaska. This river is designated a Wild and Scenic Corridor by the Alaska National Interest Lands Conservation Act. Current users of the river include placer mine operators, as well as boaters and rafters. Along the North Fork Fortymile River, and just below its confluence with the South Fork (fig. 1), mining is limited to a few small suction dredges which, combined, produce as much as a few hundred ounces of gold per year. In this area, some potential environmental concerns have been raised associated with the mining activities, including increased turbidity of the river water; adverse impact on the overall chemical quality of the river water; and potential additions of specific toxic elements, such as arsenic, to the river during mining operations.

A cooperative effort between the USGS and the AKDNR was initiated to provide data to address these concerns as well as regional geochemical data. In June 1997, field measurements were made for pH, turbidity, electrical conductivity (a measure of the total dissolved concentrations of mineral salts), and stream discharge for the Fortymile River and many of its tributaries. Samples were collected at the same time for chemical analyses, including trace-metal analyses, in the USGS laboratories in Denver, Colorado. This Fact Sheet summarizes some of the results of this ongoing study, especially in regard to the suction dredge mine sites.

TURBIDITY SURVEYS

Two sites were studied where suction dredges were operating in the North Fork Fortymile River, as shown in figure 1. Samples were collected on a grid extending downstream from the dredges as they were operating and compared to measurements made upstream of the dredges. One dredge had a 10-inch diameter intake hose and was working relatively fine sediments on a smooth but fast section of the river. The other dredge had an 8-inch intake and was working coarser sediments in a shallower reach of the river. State regulations require that suction dredges may not increase the turbidity of the river by more than 5 nephelometric turbidity units (NTU), 500 feet (≈150 m) downstream. In both cases, the dredges were well within compliance with this regulation. The results of the turbidity survey for the 10-inch dredge are shown in figure 2. Turbidity values behind the 8-inch dredge were lower, because the smaller intake was moving less sediment material, and because the coarser sediments being worked by the 8-inch dredge settled more rapidly.

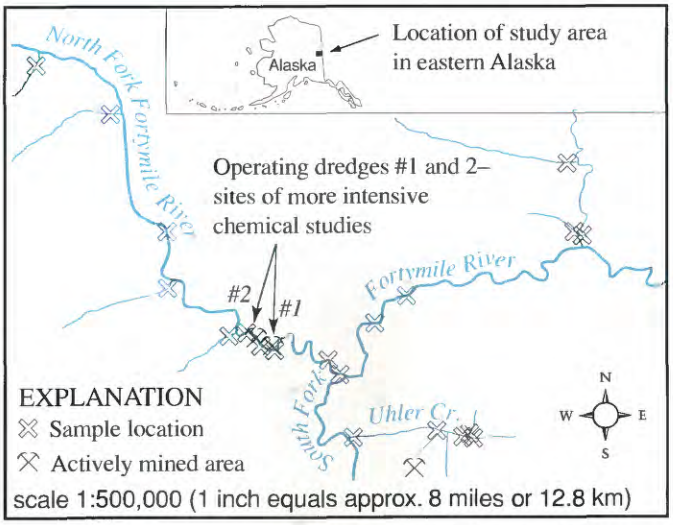

Figure 1. Schematic map of the Fortymile River study area. The town of Chicken lies about 20 miles (32 km) to the south.

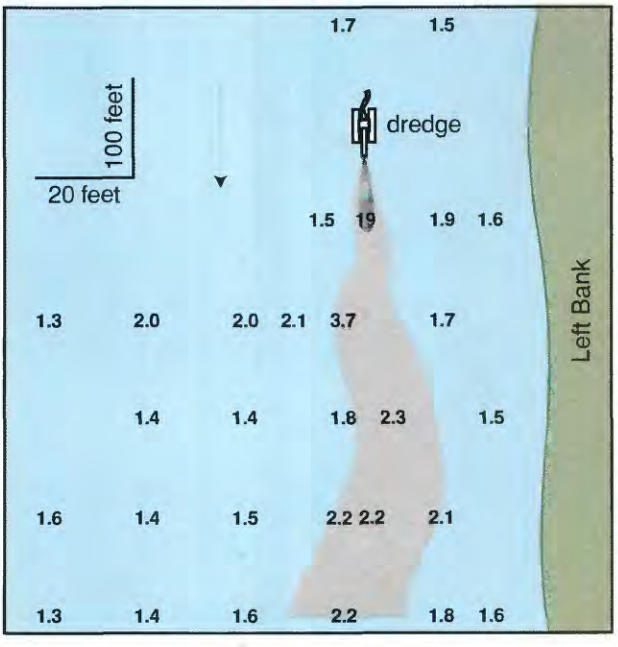

Figure 2. Results of turbidity survey behind an operating 10-inch suction dredge (site #1 on fig. 1). All numbers shown are in NTU, or nephelometric turbidity units; the standard unit of turbidity. The right bank of the river is off the edge of the figure. The approximate shape of the plume is shown in gray. Note that the figure is exaggerated 5x horizontally, so the plume is actually much narrower than it appears in the figure. To comply with State regulations, dredges may not increase the turbidity of the river by more than 5 NTU, 500 feet behind the dredge.

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Comparison of Dredge Turbidity to Regional Values

The turbidity values found in the dredge studies fall within the range of turbidity values found for currently mined areas of the Fortymile River and many of its unmined tributaries. Figure 3 shows the ranges of turbidity values observed along the horizontal axis, and the number of samples which fall within each of those ranges. For example, 25 samples had turbidity between 1.0 and 1.5 NTU, 22 of which were in a dredged area. The highest turbidity value was from an unmined tributary to Uhler Creek; the lowest from a number of different tributaries to the North Fork. As seen in the figure, there is no appreciable difference in the distribution of turbidity values between mined and unmined areas.

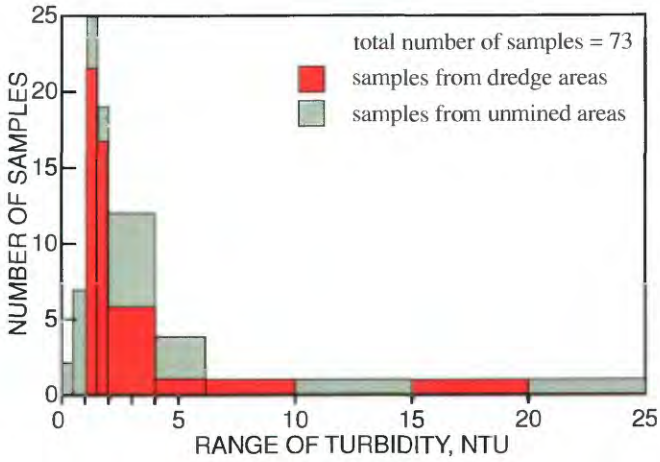

Figure 3. A comparison of turbidity values between mined and unmined areas shows that the suction dredge mining does not affect the turbidity of the Fortymile River system. The highest turbidity values from the dredge areas are within 200 feet (60 m) of the back of the two operating dredges which were studied.

CHEMICAL SURVEYS

Water-quality samples were collected at three points 200 feet behind each of the two operating suction dredges. One sample was collected on either side of the plume, and one in the center of the plume. The samples were passed through a filter with a nominal pore size of 0.45 micrometers and acidified to a pH less than about 2. Results are shown in the table below. Samples 1A, 1C, 2A, and 2C are from either side of the plume behind dredges 1 and 2, respectively. Samples 1B and 2B are from the center of each plume. All concentrations given are in micrograms per liter, except pH, which is expressed in standard units.

	Dredge 1			Dredge 2		
	1A	1B	1C	2A	2B	2C
pH	7.7	7.6	7.8	7.0	7.5	7.5
Arsenic	0.3	0.3	0.3	0.3	0.3	0.3
Iron	110.	110.	110.	100	97	100
Chromium	2	2	3	3	3	3
Cadmium	all less than 0.02 micrograms per liter					
Cobalt	0.07	0.07	0.06	0.06	0.05	0.05
Zinc	0.8	0.6	0.8	1.0	1.0	1.0
Lead	all less than 0.05 micrograms per liter					

The data show similar water-quality values for samples collected within and on either side of the dredge plumes. Further, the values shown in the table are roughly equal to or lower than the regional average concentrations for each dissolved metal, based on the analyses of 25 samples collected throughout the area. Therefore, suction dredging appears to have no measurable effect on the chemistry of the Fortymile River within this study area. We have observed greater variations in the natural stream chemistry in the region than in the dredge areas. Preliminary results from three undisturbed sites suggest that the shallow ground water may be of poorer quality in some pyrite-rich outcrop areas. This water could be discharging to the surface water, leading to increased dissolved metal loads.

CONCLUSIONS

The data collected for this study help establish regional background geochemical values for the waters in the Fortymile River system. As seen in the chemical and turbidity data, any variations in water quality due to the suction dredging activity fall within the natural variations in water quality. This conclusion is further supported by the other water-quality data collected throughout the region, at the sites shown in figure 1.

Current and future work on the Fortymile River system is directed at understanding the natural variations in water chemistry throughout the area. The primary factors causing these variations are probably variations in bedrock geology and mineral content, as the surface waters come into contact with the bedrock throughout their flow history.

REFERENCES TO CONSULT

The USGS website: http://www.usgs.gov

Gough, L., Day, W., Crock, J., Gamble, B., and Henning, M., 1997, Placer-Gold Mining in Alaska— Cooperative studies on the effect of suction dredge operations on the Fortymile River: U.S. Geological Survey Fact Sheet FS-155-97.

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