

Environmental Effects and Monitoring of Abandoned Drilling Muds: The Wrangell-St. Elias Approach

By Timothy E. Law

Who would think that within the largest U.S. national park there exist uncontained drilling muds with high concentrations of heavy metals? Wrangell-St. Elias National Park and Preserve, 13.2 million acres in southeast Alaska, inherited this reality when the park was established by Congress in December 1980, under the Alaska National Interests Lands Conservation Act (ANILCA, PL 96-487).

In 1984, a comprehensive inventory for waste materials was conducted on park lands, focusing on numerous abandoned mining claims, milling sites, and mineral and oil exploration locations. This is the story of just one such site, located in a remote area west of Yakutat Bay on the Gulf of Alaska, where approximately 83.5 tons of unused drilling muds, abandoned in 1962 by an oil exploration company, were found.

During the original operation, from the mid-50s to the early 60s, at least nine wells were drilled in the Dry Bay and Icy Bay areas, on the Malaspina Glacier forelands, and near the village of Yakutat. The Sudden Stream waste site lies on the Malaspina forelands in southeast Alaska, approximately 20 miles northwest of Yakutat village. The mud pile is about 0.5 miles inland, at the end of a revegetating air strip that was constructed from local gravels and top soil. The area is generally flat, less than 50 feet above sea level, and has a characteristic high water table (6 to 10 feet).

Early Site History

It is believed that Colorado Oil and Gas Corp., which changed its name in 1976 to Derby Oil Co. out of Delaware, built and used the air strip as a staging area for drilling operations. About 3 to 5 acres of land were disturbed by the airstrip construction. Total area being affected by the *unused* drilling muds is still undetermined, but it appears that the majority of metals from the waste pile is confined to a radius of approximately 150 to 200 feet.

In the late summer of 1962, a well was drilled less than 150 feet from the mud pile to more than 12,000 feet in depth. The question remains – what happened to the *used* muds from this operation? A distinct possibility is that these muds, which may amount to a substantial volume and would contain high concentrations of heavy metals, were disposed of in the area around the well site and along the airstrip.

When the exploration ended, the *unused* muds were abandoned, stacked in their original heavy paper sacks, and housed in a plywood shelter. Over time, the shelter deteriorated and collapsed, exposing the muds to weathering and leaching. In a preliminary site inventory, five mud types were identified: Q-Broxin (16,000 lbs), Maccowate (43,200 lbs), Economy Gel (52,800 lbs), Hydrogel (68,800 lbs) and Arcc (4,500 lbs).

Laboratory analysis showed the highest heavy metal concentrations were barium (Ba) and chromium (Cr). Of primary concern were the drilling muds Maccowate and Q-Broxin, which showed concentrations of 480,000 ppm (48%) barium and 2,000 ppm (2%) chromium by weight, respectively.

Preliminary Investigations

Sampling and analysis of the soil and water were conducted to determine the extent of metals migration outward from the mud pile. Mobile forms of these met-

als can enter the surrounding environment primarily via two transport mechanisms, water leaching by precipitation and aerial transfer by wind. Initial results showed the presence of both barium and chromium in the soil and surface water within 150 feet of the mud pile. Ranges of metal concentrations in the water were 50 to 220 ug/l for barium and 50 to 230 ug/l for chromium; in the soil, 1,000 to 1,590 for barium and 1 to 66,700 ug/l for chromium.

The EPA and Alaska Department of Environmental Conservation (ADEC) standards for domestic water supplies are 50 ug/l for chromium and 1,000 ug/l for barium. EPA also indicates the limits for aquatic life are 100 ug/l (Cr) and 50,000 (Ba). Preliminary results thus showed that directly around the site there were concentrations of chromium in excess of applicable state and federal regulations for drinking water.

Background information and sampling results were reported to EPA and ADEC. In the summer of 1986, EPA made an onsite evaluation of the threat to the environment and to the general public. With completion of a preliminary assessment, EPA recommended that NPS should pursue cleanup activities and continue monitoring the site. Major findings showed a potential for metal transport into the groundwater, surface water, air, soil, flora, and fauna at the measured heavy metal levels. The possibility also exists for incorporation of metals into the food chain.

Under the current EPA hazardous ranking system, two factors are of top priority: the site's remoteness (i.e. immediate threat to a populated area) and the potential for contamination of a public drinking water source. Since this site is located a substantial distance from a nearby community and public drinking water source (about 20 miles), it was given a low hazard ranking by EPA and did not qualify for placement on the National Priorities List (NPL) for cleanup funding. However, EPA did submit a funding request for initial site cleanup to the Office of Management and Budget (OMB). This was rejected. The Wrangell-St. Elias NP staff obtained support from the Alaska Regional office for a sampling

program in the summers of 1987 and 1988 to identify the spread of barium and chromium.

Sampling and Analysis

To gain full understanding of how the environment was being affected around the waste site and to design and implement a long term monitoring program, an expanded, multiple-phase sampling scheme, including water, soil, vegetation, and aquatic life was needed. The premise of the field work completed in the last two seasons was to document more concisely the degree of metal concentrations and the area being affected.

In summer 1987, 10 locations were established for sampling surface water in streams, lakes, and standing pools around the site and groundwater was collected from soil pits excavated to the water table. Within ~ 200 feet of the waste pile, metal concentrations ranged from 60 to 88,000 ug/l (Ba) and ~ 5.0-665 ug/l (Cr). Metals were spreading in all directions, however highest concentrations were noted in water samples collected about 90 to 100 feet downslope and in the direction of leachate flow away from the waste pile. Farther from the waste pile (~ 1800 feet), toward Sudden Stream, an outlet from Malaspina Lake, Ba and Cr levels dropped off to 130 ug/l and 20 ug/l respectively.

In summer 1988 a more intensive effort included sampling of water, soil, vegetation, and fish/mollusks around the waste site and in control sites. The intent was to obtain a broader spectrum of data that more accurately identified the extent of water and soil affected and for the first time included vegetation and aquatic life. Methods used for collection, preservation, and shipment of field samples followed USFWS procedures. Major findings were these:

(1) Metals are being leached onto the ground and into the surface water and soil directly around the site. These elevated concentrations, ~ 6 to 100 times background, are found primarily within a radius of 150 to 200 feet downslope and to the east of the waste pile. A substantial decrease occurs in metal concentrations



Pile of unused drilling mud in a deteriorated condition, showing scattered debris and remains of the plywood shelter in which it was enclosed. (Photo by Timothy Law)

from ground surface to a two-foot depth in the soil profile.

(2) Significantly elevated concentrations of Ba and Cr were found in the mud and water samples collected from a small pond on the north edge of the airstrip, several hundred feet east of the mud pile . . . possibly due to leachate flow from the waste site or from *used* drilling muds disposed of in that area.

(3) All vegetation samples from the site showed levels of Ba and Cr higher than background concentrations. There was no correlation between distance from the site up to 75 feet and metal concentrations in the plants. Also, there was no distinction between metals incorporated *in* the plant tissues and metals present *on* the plants.

(4) Small fish taken within 200 feet of the waste pile (i.e. sticklebacks) showed elevated levels of Ba (9.1 ug/g). Fish collected in outlet rivers from Malaspina Lake, about 0.5 to 0.75 miles from the waste site, showed Ba and Cr levels consistent with control samples.

(5) Mollusks (fresh water mussels) collected in a lake about 250 feet from the waste pile showed Ba concentrations of 120 ug/g in the tissues. More mollusk samples at control sites need analysis for comparison.

Results clearly indicate that Ba and Cr are affecting the water, soil, vegetation, and some aquatic life in the area around the waste pile. However, except for the pond which is more than 500 feet away, the affected area appears to be confined to within about 250 feet of the waste site.

As per EPA recommendations, Wrangell-St. Elias NP&P will continue monitoring and pursue cleanup of the waste site. Additional sampling and analysis will enable us to map more precisely the areas affected and any other sources of contamination (i.e. *used* drilling mud).

Development of a long term groundwater monitoring program, including installation of monitoring wells and collection and analysis of groundwater samples, will be followed by preparation of a feasibility plan for alternative cleanup options. Once a specific option emerges, detailed specs and a site safety plan will be drafted and funding will be sought.

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