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Out of Sight, Out of Mine: Ocean Dumping of Mine Wastes

The world's oceans, already imperiled, face a new threat.

by Robert Moran, Amanda Reichelt-Brushett, and Roy Young

Beginning in 1996 and continuing through at least mid-2004, the Newmont Minahasa Raya gold mine dumped 2,000 tons per day of wastes into the tropical, coral-rich waters of Buyat Bay, off the island of Sulawesi, Indonesia—waters that previously had been the main source of food and income for local families. Soon stories began circulating that the fish were disappearing and that those remaining had deformities. Villagers also complained of strange skin rashes, tumors, and other forms of disease, all of which they claimed started after the waste disposal began. An independent team of scientists was commissioned by the Indonesian government to review the information and concluded that contamination by the mine had occurred. Newmont Mining Corporation, the U.S.-based parent company, commissioned its own studies and continually claimed that the data showed no water contamination—although they neglected to mention that these very studies clearly revealed the polluting of bay sediments by mercury, arsenic, antimony, and other metals and the likely uptake of these pollutants by bottom-dwelling organisms.

Buyat stories appeared everywhere in the media throughout the Pacific and quickly were investigated by the *New York Times*. Soon the Indonesian government arrested the head of Newmont Minahasa Raya and five other employees. A series of lawsuits followed. In 2007, an Indonesian court found both Newmont and its local director not guilty of the alleged crimes, but the state prosecutor subsequently appealed the ruling to the Indonesian Supreme Court. Some villagers were relocated in response to fears about the alleged contamination, but the claims and counterclaims have left the villagers confused and the issue hanging. Meanwhile, Newmont received permission

from the Indonesian government to commence operating a copper-gold mine, Batu Hijau, which dumps up to 160,000 tons per day of wastes off the coast of another Indonesian island, Sumbawa—70 to 80 times the volume of waste disposed into Buyat Bay.

Tailings Trail

This story is a classic example of a common tragedy, usually occurring in the developing world, in which it is largely impossible to render an unbiased verdict because most of the technical data are collected by the interested company or their paid consultants; in which the local environmental oversight and legal systems are incapable of reaching an informed ruling, especially where so much outside money and political influence easily control the processes; and in which all sides therefore mistrust the actions of the officials and the companies.

The tailings (processed wastes) from the Minahasa Raya and Batu Hijau mines were discharged into the oceans via near-shore pipelines at relatively shallow depths: the pipeline from Minahasa Raya into Buyat Bay ran 1.0 kilometer offshore and terminated at 82 meters depth; the Batu Hijau pipeline discharges about 2.9 kilometers offshore at 108 meters depth. Given all the Buyat Bay troubles, this seems exceptionally shallow, especially as many oceanographers say that truly deep waters begin at about 800 to 1,000 meters depth. Newmont argues that the Batu Hijau tailings migrate toward their final resting place in the Java Trench at depths in excess of 4,000 meters, although what little is known about ocean stratification and current flows reveals remarkable complexity and unpredictability.

In fact, nobody knows where all those tailings might be



Courtesy PT Newmont Nusa Tenggara



Left: A portion of the PT Newmont Minahasa Raya gold mine near Buyat Bay.

Above: Onshore tailings pipeline from the mine.

going. And it matters: more than 50 million tons of waste per year are discharged into the ocean from Batu Hijau alone. Several additional operating mines employ submarine tailings disposal (STD), and international corporations are pushing for many more. The desire for developed-world infrastructure and consumer products worldwide is driving a huge (and notwithstanding the recent economic slump, longterm) increase in the demand for metals, especially in cash-strapped countries near Asia that have relatively “flexible” business and environmental practices.

Mine tailings have been dumped into near-shore, shallow marine environments, either directly through pipelines or via rivers, for many decades, possibly for at least the last 100 years. These practices have produced documented impacts to marine life (and alleged impacts to humans) resulting in heated legal disputes in Peru, Chile, Indonesia, and the Philippines among other nations. Modern open-pit metal mines generate much greater volumes of waste than did historical underground mining; approximately 99 percent of all rock moved and processed at modern facilities ends as waste. At most mines, these wastes must be stored and managed forever. Hence, there is a great desire to send the wastes somewhere else—preferably out of sight. Traditional near-shore, shallow marine STD is

unacceptable in modern developed countries, and so industry, often with government assistance, has attempted to justify the argument that disposal of tailings at much greater depths will be free of impacts. Part of the approach has been semantic: simply changing the process name from submarine tailings disposal to the more benign-sounding deep-sea tailings placement (DSTP). For modern mines located in developing countries, especially those in tropical regions with high rainfall and strong earthquakes, industry has argued that DSTP is the best solution. It is much less expensive for them, and they acknowledge no significant impacts.

Indonesia, the Philippines, Malaysia, Papua New Guinea (PNG), the Solomon Islands, and East Timor have formed a partnership, the Coral Triangle Initiative, to safeguard the region’s marine environment and coastal resources. This “triangle” hosts the highest biodiversity of marine life on Earth. Yet mining firms and member governments consider it acceptable to discharge hundreds of thousands of tons of chemical wastes per day into these waters. Would the Europeans allow such madness to occur off the tourist-swarmed southern European coasts, the Costa Brava, Provence, or the Adriatic?

Strange Brew

Even though these wastes are discharged into the collective waters of the world’s oceans, monitoring of the resources is conducted by the companies and their consultants, and details are often withheld from the public. However, based on data from similar copper-gold operations that dispose of their tailings on land and on partial data from some STD operations, we can get a glimpse into the nature of this chemical soup.

Tailings are composed of crushed, mineralized rock and process chemicals. Rock components include almost every natural element in the periodic table, but common pollutants are arsenic, cadmium, copper, lead, mercury, nickel,

selenium, zinc, and uranium. Processing of metal ores typically involves the addition of chemicals such as sodium hydroxide, sulfuric acid, sodium cyanide, copper sulfate, sulfur dioxide, xanthates, diesel oil, amines, polypropylene glycol methyl ether, and dozens more. Most of the chemicals and rock components are known to be individually toxic to marine organisms if present in sufficient concentrations. The synergistic toxic effects of such complicated mixtures of dozens of chemicals are unknown.



Kemal Jufri/Polaris

Boats line the shore in front of a village on Buyat Bay in March 2005.

Industry knows the toxicity of the individual elements well from the numerous contamination episodes and lawsuits that have resulted worldwide when tailings have been discharged into sensitive areas on land and into shallow marine environments. The U.S. government long ago identified land-based mining as the industry that generates the largest volumes of toxic wastes. These wastes have repeatedly been found toxic to myriad terrestrial and aquatic organisms and are responsible for contaminating thousands of kilometers of rivers and aquifers in countless locations. Disposal of mine tailings into shallow marine environments has contaminated marine waters and forced local populations to restrict their consumption of fish and shellfish in Peru, Chile, Indonesia, the Philippines, and elsewhere. (Local populations have also alleged that these practices harm human health, but usually lack the technical and medical support to win such claims in court.)

Thus the position of some companies has been that dumping these wastes into deep waters is the solution. They argue that such wastes can be carefully placed at the mouths of marine canyons, where they then flow by gravity down to the deepest waters, and that all impacts to either the shallow or deeper organisms are avoided. At these depths, they maintain, chemical reactions proceed at such slow rates that the concentrations of toxic substances released from the tailings will generate insignificant impacts to marine communities.

Some industry representatives have even made the disingenuous statement that tailings are inert (non-reactive). In 2005, the CEO of Newmont Mining said at the company's annual shareholders meeting that "once processed [referring to gold tailings], all that remains is sand."

Other experts argue that this is far too simplistic. Australian government scientists have reported the existence of marine currents in northern Papua New Guinea waters that move upward in canyons from the sea floor, carrying materials back toward the coasts. Their studies also show that much of the river sediment discharging into the bays of northern PNG does not enter the marine canyons, but instead is carried off to the northwest and deposited hundreds or thousands of kilometers away.

There are literally hundreds of studies showing the sensitivity of various shallow marine communities to metals and other contaminants in industrial wastes. The research also demonstrates the lethal smothering of shallow communities by tailings sediments. Studies by one of the authors of this article (Reichelt-Brushett) show that the critical life stages of coral reproduction are extremely sensitive to elevated loads of trace metals, particularly copper. Several U.S. oceanographers state that below ordinary SCUBA-diver-depths (about 30 meters) the impacts of pollution and sedimentation on shallow-water ecosystems, including coral reefs, remain largely unexplored. Our understanding of even these shallow reef systems is limited by logistics, accessibility, and funding.

Much less is known about deep marine communities and related contamination below about 800 meters (and for that matter, little is known about the intermediate zone between 100 and 800 meters, either). While it is thought that some deep-sea communities cope with high sedimentation rates, little is understood about the impacts of trace metals and other pollutants (from a variety of sources) on these ecosystems. Few, if any, studies are available that report on the impacts of tailings contaminants on tropical marine or deep-sea organisms, but the few studies that have been done are troubling. For example, from 1986 through 1992 the U.S. government encouraged the disposal of municipal sewage wastes in deep marine waters (2,500 meters) at the "106-mile dumpsite" off the New Jersey coast. This dumping was halted after various studies showed harmful impacts to the plentiful and diverse deep marine communities and to water quality, due to the metals, toxic organic compounds, bacteria, and viruses contained in the sewage sludge.

Most significantly, the natural-resources research arms of the Australian and Canadian governments conducted two reviews of the available literature on DSTP beginning in 2001. The first report was jointly authored by the Australia Commonwealth Scientific and Industrial Research Organization (CSIRO) and the Canada Centre for Mineral and Energy Technology (CANMET) and completed in September 2004. It was released to an advisory group, but never made available to the general public. The second report, authored by CANMET, has never been

made publicly available. When we contacted the CANMET author in August 2008, he was unwilling to provide copies of either report, stating that the studies were originally commissioned by several international mining companies and that these companies controlled the dissemination of the studies.

In fact, most of the studies reviewed in the 2004 report dealt with disposal into relatively shallow marine waters, and almost none evaluated tropical settings. Few relevant studies on truly deep waters existed then, or exist even now. In fact, these two research reviews identified major gaps in the technical knowledge relating to the precise fate and toxicity of these wastes and their impacts on marine communities. The sections on “Recommendations for Further Work” and “Research Needed to Fill Knowledge Gaps” are three pages long. Clearly the authors were saying: we don’t adequately understand the complicated impacts.

Evaluating the realistic consequences of marine tailings disposal is impeded by several economic and political realities. It is extremely costly to collect and analyze mining environmental samples at terrestrial and shallow marine sites, and many times more expensive in deep marine waters; so much so that it is essentially beyond the resources of many developing world governments and certainly untouchable by public interest groups. Also, there has been a general trend worldwide to push the national research agencies of developed-world governments to behave more like private industry. That is, they are required to find commercial sources of funding for much of their work and to interact more closely with industry. Without some commercial incentive, these large research groups will generally not undertake such costly and controversial research. Hence most of the research on waters and communities near individual mines is collected and interpreted by the mining companies or their paid consultants. The main goal of such studies is to obtain the necessary operating permits, not raise uncomfortable questions. These projects can continue for decades, providing the consultants’ primary source of income. More directly, consultants will never be hired again by any mining corporation if their statements are unacceptable. (As the U.S. writer Upton Sinclair insightfully noted, “It is difficult to get a man to understand something when his salary depends on his not understanding it.”) Finally, the national government oversight agencies are in a double bind: they are required to promote mining, which frequently supplies a major source of national revenue, and also enforce the laws. Normally, the government staff lack the technical skills and support to act as a reliable check and balance on industry practices.

Thus the fundamental dilemma is that many of the important issues have not been studied adequately in tropical or truly deep waters by independent and financially disinterested scientists. The available studies have several major flaws: they failed to study communities below about 150 meters’ depth; they were conducted or directed by interested parties; and they generally looked only at short-term impacts. To be mean-

ingful, such studies must evaluate conditions over the long term, probably decades. Most DSTP sites lack monitoring locations outside the immediate disposal area and so there is really no way to demonstrate that some tailings fail to harm shallow waters and communities. Moreover, because the interactions of marine physical, biological, chemical, toxicological, engineering, oceanographic, and socioeconomic factors with human activities are extremely complex, the tendency is simply to present study results in isolation rather than to fully



Kemal Jufri/Polaris

A Buyat Bay resident is consoled as she leaves the remains of her village under a voluntary relocation program in 2005. The bay was declared contaminated by an Indonesian government panel.

integrate them across disciplines; thus the complexities are lost. It’s so much easier to say, “That is outside my expertise.”

Knowledge and Power

Two of us (Moran and Reichelt-Brushett) got a glimpse into what is driving marine disposal of mine wastes at a European Union-funded conference held in Madang, Papua New Guinea, in early November 2008. The gathering was billed as an opportunity to “assess all existing information on past and present mining operations using deep sea tailings placement... in Papua New Guinea...” and “provide guidelines for future DSTP marine environmental monitoring in the context of international best practice.” The conference was also intended to present the results of recent, independent research efforts on DSTP in Papua New Guinea waters (specifically from near the Misima and Lihir Mines). To this end, the E.U. had contracted with the Scottish Association for Marine Science (SAMS) to review the available literature and conduct sampling activities near the two mines.

Upon our arrival, several strange aspects became immediately apparent. Most of the invited technical speakers represented either industry or government perspectives; almost no general public involvement had been arranged. Ultimately

a few representatives of citizens groups did attend, but Madang is far off the beaten path and attending the conference was too expensive for most citizens groups.

None of the industry speakers or their consultants would provide their actual chemical or biological data to the other attendees. When the regional director of Newmont Asia Pacific made a presentation on the impact-free disposal of tailings at the Batu Hijau mine, he was asked to make public the detailed chemical contents of the tailings. He declined: it was not possible at this time, he said, but hopefully in two years; the company wanted to protect the ability of its scientists to publish on these matters. However, this mine had been operating since roughly 2000. Thus, the audience was being told that the chemical details of what was being dumped would not be revealed until more than 10 years after operations commenced.

The E.U. contractor, SAMS, was staffed by clearly competent marine scientists, but had no previous experience with metal mining projects or working in tropical waters. SAMS had little appreciation for the sensitive political and citizens' concerns that normally intrude into such projects. Its work and its scope were actually directed by another E.U. consultant, formerly from the mining industry. SAMS had not actually completed its research and was unable to present most of its conclusions, but it did identify notable changes in the communities of bottom-dwelling organisms from tailings discharges at 100-meter depths. However, the areas studied received wastes from relatively small mines, not large-scale operations as are proposed, so the situations were not really comparable to truly deep disposal scenarios. Nevertheless, on the last day SAMS presented a set of guidelines for future DSTP monitoring, for comment and consideration by the attendees. It is unclear who actually authored these guidelines. Apparently, the organizers had assumed that the attendees would ultimately approve the guidelines before the conference ended, but no such consensus was attained.

The PNG government seemed to want public support for a long-delayed nickel mine, the Ramu project, located not far from Madang (apparently the reason for the remote conference site). The Ramu mine is to be operated largely by a Chinese corporation and it is likely that most of the production would go to China. Thus, the PNG government certainly wanted to demonstrate via the conference that environmental and other impacts from DSTP were acceptable.

Was it the intent of these E.U. representatives to promote deep sea tailings disposal? That is unclear, but one could certainly conclude as much. At minimum, they see their role as one of assisting the PNG and other governments in promoting international investment in mining. Do such governments actually have the ability to competently oversee such complex development projects? It's unlikely without major improvements in the national governance capabilities, as was concluded by the two-year Extractive Industries Review study conducted by an independent team advising the World Bank and released in 2003.

If the E.U. does intend to promote DSTP, it may be only selectively. DSTP is practiced in some regions because many national and international governing bodies have failed to legally forbid, and have largely ignored, such practices. However, submarine disposal of mine wastes has been effectively banned in the waters of the United States, Canada, Australia, and the Philippines, and the European Union's own Marine Directive (June 2008) clearly discourages such practices in the waters of any E.U. member country. The Directive tellingly states, "...the Community needs to reduce its impact on marine waters regardless of where their effects occur." One would expect that the United Nations Convention on the Law of the Sea would also forbid tailings disposal, but it has historically been exempted from the Convention.

Insult to Injury?

Read almost any news source and one learns of another assault on the health of marine resources. If it isn't over-fishing and declining catches, it is coastal dead zones in the Gulf of Mexico and many other places, restrictions on the consumption of fish due to mercury content, or the loss of corals and other species due to heat stress. Climate change is causing an increase in the carbon dioxide content of ocean waters, increasing their acidity. Given such extreme pressures on marine ecosystems, it seems foolish to impose additional stresses from disposal of millions of tons of mine wastes—especially when government research scientists say we simply don't understand the risks. And, unlike land disposal, the impacts from deep submarine disposal will be largely irreversible.

Both mining of metals and disposal of mine wastes in the world's oceans clearly involve the ancient concept of the "commons"—resources that are neither public nor private but which are held and used jointly. Disposal of tailings into the oceans at any depth has the potential to degrade a tremendous range of commonly utilized resources, but local publics lack the tools to demonstrate conclusively that such broad consequences may be occurring. At present, only the mining corporations have the financial and political power to have their technical arguments heard. Given the myriad uncertainties noted in the international technical literature, it is all but certain that we and our children will pay for this parochial view on ocean management.

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