Conflicts over mining and water: Lessons from Peru

1. Lead-in

Impacts on water quality and quantity are among the most contentious aspects of mining projects. Companies insist that the use of modern technologies will ensure environmentally friendly mining practices. However, evidence of the negative environmental impacts of past mining activity cause local and downstream populations to worry that their water supply may be adversely affected by new mining activities. We report on one mine site in Peru where water has become a particularly conflictive issue. We then provide detailed information on how to design a monitoring plan to recover trust between mining companies and local communities. A well-designed and executed monitoring plan for water quantity and quality is critical to foster dialogue, consensus, trust and transparency between mine and community.

2. Main text

Conflicts over mining and contamination in the Andes

The expansion of mineral extraction is accelerating in the Andes. Alongside optimism that this will lead to significant economic growth there is concern that the environmental costs might be unacceptably large. The stakes in these conflicts are high, affecting everything from local livelihood sustainability to the solvency of national governments. In Ecuador some have called for a constitutional ban on open pit mining, while in Peru fears for water quantity and quality have triggered numerous and sometimes violent conflicts between miners and communities.

One particularly conflictive mine-site has been the Rio Blanco Project in the Department of Piura, located along Peru's northern border with Ecuador. This conflict involved a UK registered company, Monterrico Metals plc, and has been monitored by various organizations, among them the Peru Support Group, a British civic association. Because of conflicting testimony in the British Parliament by the mining company and by local stakeholders in 2006, the Peru Support Group (or PSG) agreed to form an independent delegation to visit the region and consider the nature of the conflict, its causes, and possible ways forward. The delegation was composed of ourselves, a member of the UK Parliament, a journalist and a social anthropologist. We engaged with the mining company, national government, and a range of national, regional and community level interest groups in an effort to understand the many dimensions of this conflict and to identify ways in which addressing water and other issues might reduce levels of tension

(Photo 1). Our report (see Further Reading) was presented at the UK Houses of Parliament on March 27th, 2007, in Lima on May 17th, and Piura on May 18th, 2007. Here we focus specifically on our proposals for a water monitoring scheme that could contribute to more productive relationships between mining and development. We believe that this monitoring scheme is transferable to other proposed mining sites in Peru, South America, and other continents.

Water and mining in Peru

Peru is South America's most water-stressed country. Seventy percent of its population lives to the west of the Andes, where less than 2 percent of water resources are found. Water draining from the Andean highlands serves as a water tower that supports this downstream population and attendant agricultural activities, including the country's dynamic agricultural export economy. Climate change induced melting of Andean glaciers places further stress on this water source. The Tyndall Centre for Climate Change Research identifies Peru as the world's third most vulnerable country to the impacts of climate change (PSG, 2008; Racovitaneu et al. 2008).

Further pressure comes from the rapid expansion of mining in Peru. While estimates are that mining uses only five percent or so of Peru's water, this understates the significance of this use. First, many mining concessions are located in headwater areas in the high Andes; and second mining can adversely affect water quality, and these impacts on quality can extend well beyond the mine site, relayed across space by rivers and aquifers. They can also extend over time, lasting generations.

The impacts of mining on water quality and environmental health originate in two main ways: through acid mine drainage (AMD), and through the escape of ancillary products in processes of production and transformation. AMD occurs because of the removal of rock during the mining process. Rock is broken up in order to gain access to the ore – this rock is then deposited elsewhere on the mine site. The ore bearing rock is ground down much more thoroughly during the process of removing the mineral. The remaining ground down rock is then stored in tailings. In each instance, the surface area of the rock exposed to air and water grows exponentially, increasing rates of chemical reaction as a result of which contaminants are released into the environment. AMD involves the transmission of these highly toxic contaminants through the movement of water. For example, in July 2008 Peru declared a state of emergency at a mine near Lima over fears that arsenic, lead and cadmium from its tailings dam could pollute the main water supply for the capital. The Coricancha mine in the Tamboraque region has been weakened by seismic activity and subterranean water filtration.

The severe impacts that mining can have on water is clearly visible in Peru's landscape. It has been estimated, for instance, that every year mining and metallurgy release over thirteen billion cubic metres of effluents into water courses. Consequently, though attracted by the possible economic benefits that mining might bring, populations also worry about the potential for adverse environmental impacts and the implications that these will have for livelihoods, consumption, well being and health. Some experts calculate that more than fifty percent of Peru's peasant communities have been affected by mining activities, leading to the creation of organizations such as the National Coordinator of Mine Affected Communities. Many nongovernmental, community groups and urban environmental committees have also expressed significant concerns about water and mining, as has the office of the Ombudsman (Defensoría del Pueblo). Nonetheless, in Peru government policy has encouraged the rapid growth of mining investment.

Other factors aggravate this situation. There is an overall absence of clear, reliable, transparent and independent information on the nature of the risks at stake. Also, the long histories of poor corporate practice related to pollution in Andean environments, and of weak regulation on the part of the state, have left communities distrustful of central government and mining companies. These factors and others have driven escalating conflict over the last decade. This has been especially severe where mining investment has increased rapidly in regions with no prior tradition of mining. One of the most conflictive of these has been Piura (Photo 2).

Piura: A new mining frontier?

The Department of Piura stretches from the high Andes to the Pacific coast. The coast is made productive by several irrigation projects channeling Andean water to farms used both for agricultural exports and domestic food production. The highlands are home to poorer peasant communities whose economies combine market and subsistence agriculture, migration and off-farm labour.

Between 1998 and 2003 Piura became famous in mining debates because of a conflict between the residents of Tambogrande and a Canadian company, Manhattan Minerals. Manhattan departed shortly after a local referendum in which over 93% voted against mining. As Manhattan was departing, Monterrico Metals was beginning exploration work in Piura's highland provinces of Ayabaca and Huancabamba. This elicited similarly severe conflicts. Two peasants were killed during different protests, while the church, state and other national and international actors sought to calm the situation. This conflict also led to a referendum held in September 2007, and again over 90% of voters were against mining. The company, the central government and the President of Peru continue to insist, though, that the mine will go ahead.

One of the main concerns of local and downstream communities relates to the effects that the mine would have on water quality and quantity. Activists and the company disagree on which drainage basins will be affected by the mine, and on the capacity of the company to control for its environmental impacts. The conflict has reached such a depth that all parties appear to have lost trust in each other, and nobody believes claims that others make. A way forward that is satisfactory to the local peasants and other stakeholders, the central government, and the mining company is not obvious.

We do not argue that establishing a system for providing transparent, independent and trusted information on water quantity and quality would resolve this conflict. However, we de argue that this project will not proceed peacefully absent such a monitoring system. Such a system would have to draw on experiences from other mine sites in Peru and the US.

Water management and mine design

A well-designed and executed monitoring plan for water quantity and quality is critical to foster dialogue, consensus, trust, and transparency between the mine and the community. Any monitoring conducted must be conducted in a transparent, publicly available, and inclusive manner. The monitoring plan should have the capacity to adapt to changes in mine operations as the mine grows, closes old operations, and potentially explores new areas. **Any monitoring plan must have a formal, independent, external verification programme.** We cannot emphasize this point enough.

The monitoring plan that we propose draws on models already in place in Peru. In all cases, the monitoring plans were enacted after complaints were formally filed against mining companies by concerned municipalities and citizens in response to perceived contamination problems caused by mining activities. We suggest, however, that monitoring plans be employed prior to and during mining activities, and not only after complaints have been made against the mining companies. We also differ in insisting that these monitoring activities be verified from the outset by independent, external organizations neither linked nor perceived to be linked to mining interests. Initiating a comprehensive monitoring project prior to the operation of the mine and through the life of the mine into the decommission phase of the mine has numerous advantages:

- Baseline information on water quantity and quality before the onset of mining activity provides data on natural conditions
- Comparison of current conditions of water quantity and quality to baseline information provides a quantitative assessment on the contribution of mining activity to current conditions.
- Often, changes in groundwater quality and quantity can be observed in monitoring wells before changes occur in stream water quantity and quality, providing an "early-warning system" so that remediation activities can be initiated prior to impacts on surface waters and/or down-gradient groundwater aquifers

Communication Plan.

Information on water quantity and quality should be communicated regularly to the public through a comprehensive communication plan. A web site that includes a detailed map of the area around the mine should be used as a basis for permanent display of data. The data types displayed should combine all data collected as part of the monitoring plan, and available historical data. Locations of sampling sites should be linked to raw data and also to graphs and other interpretive products that illustrate water quality and quantity patterns with time. The graphs should also compare the measured concentrations of analytes relative to standards.

Monitoring Activities.

Climate. Weather affects all mining operations. Recommended instrumentation includes: (1) continuous precipitation collector (Belfort is a popular supplier) for total rainfall; (2) tipping bucket precipitation collector for storm magnitude; (3) shielded air temperature; (4) shielded relative humidity; (5) wind speed; (6) wind direction. Instruments should sample about every second and means recorded and reported at 10 or 15 minute intervals.

Air quality. Mining activities have the potential to perturb air quality in the surrounding area for several reasons: removal of protective vegetative cover, disturbance by mining equipment, milling of ore into small-diameter particles that are easily transported by wind, generation of toxic metals, etc. A good manual on site requirements and methods is provided by the US National Atmospheric Deposition Program at http://nadp.sws.uiuc.edu/QA/.

Water quantity. The primary objective of the water quantity study is to quantify potential effects of the mine operations and facilities on surface water flow and flow from springs. Discharge should be measured continuously at the most important sites. A less expensive method for continuous measurements of discharge uses pressure transducers that are placed on the stream bottom. In both methods a stage-discharge relationship needs to be developed for the specific locations using manual measurements of flow. Infiltration rates to the subsurface are estimated by collecting soil cores and testing them to learn how the soils in the study area store water and how water moves through them. These samples should be tested for (1) organic content; (2) moisture retention properties (e.g., how much water a soil can hold before water flows freely from the soil); and (3) permeability (how well the soil transmits water). Soil cores should be collected periodically from the tailings pile and the same measurements conducted to understand how much water may be infiltrating the tailings pile and also flowing over the surface of the tailings pile.

Water quality. The water quality investigation should be designed to determine whether mining activities have changed the quality of water in streams and canals that flow from the Rio Blanco mining area such that the water may be unsafe for domestic and agricultural (livestock and irrigation) uses or aquatic life. Questions about the safety of water use for drinking and cooking, skin contact, agricultural use, and as aquatic habitat, can only be answered by comparing the chemicals (analytes) in sampled water to water quality standards. We recommend standards established by the World Health Organization (WHO), the U.S. Environmental Protection Agency (EPA), and Environment Canada because they all incorporate toxicological data on human health risks and risks to biota, and they all are set to be protective of human health or the health of other biota.

Water quality should be measured at all locations where water quantity is measured. Water quality should be measured daily to weekly in all surface waters that drain the mine site, including the streams that drain the valleys where the tailings and waste rock will be stored, any surface flow from processing facilities, water treatment facilities (e.g. pumping of groundwater from the open pit, sewage plant), and the Rio Blanco river below the mine site. These distributed sites should number at least 40. It is essential to sample springs down-gradient from the mine site.

Potential analytes. There are numerous chemicals (analytes) that water can be sampled for. Our suggestions are not comprehensive and may need to be modified for the Rio Blanco mine. We recommend measuring the following analytes on all water samples: (1) Alkalinity, pH, and specific conductance on unfiltered water samples. (2) Major cations (calcium, magnesium, sodium, and potassium), anions (chloride, sulfate), and reactive silicon (Si) on filtered samples. (3) Total (unfiltered) and dissolved (filtered) metals, including antimony, arsenic, barium, beryllium, boron, cadmium, chromium, copper, iron, lead, mercury, molybdenum, nickel, selenium, silver, thallium, zinc.

Groundwater. Mine facilities such as waste rock dumps and heap leach pads can reduce the amount of groundwater recharge and degrade water quality. Groundwater discharge is often an important contributor to stream flow, with the relative portion of groundwater contribution to stream flow often changing seasonally. Monitoring of groundwater quantity and/or quality can be an indicator of possible future conditions in surface waters and springs, as illustrated by Antamina mining operations.

Recommendation: it is important to install groundwater monitoring wells and to monitor water levels and water quality within the wells as an indicator of possible future conditions of water quantity and quality down gradient. Monitoring wells for water quantity should be numerous enough and spatially distributed so as to calculate groundwater velocities and discharge to down-gradient areas. Groundwater wells should be installed in down-gradient areas where water quantity or quality may potentially be changed by mining activities. Only a subset of wells need be sampled for water quality, analytes should be the same as for surface waters.

Mine Closure Plan.

Mines remain a source of pollution and contamination for decades to centuries after closure. A mine closure plan is critical to insure that acceptable water quality and quantity are maintained into the foreseeable future. Closure plans developed by Rio Blanco should define objectives, procedures, and long-term, post-mining measures necessary to maintain acceptable water quality and quantity and address long-term impacts from tailings piles, waste rock dumps, and open pits. Often, acidic lakes with high amounts of toxic metals form as abandoned pits fill with water. Mine closure plans should be developed and made public now, well in advance of the actual closure of the mine.

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3, 4. Photos, maps, graphics

1. Consulting with stakeholders

2. Mining concessions in Piura.

3. Part of Rio Blanco mine exploration site

4. Protestors in Piura

5. "Without water there is no life. Let's take care of it." Placard in Rio Blanco.

5. Further Reading

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