

Addressing Centuries of Heavy Metal Pollution: Understanding the Human Health Crisis of the Pilcomayo River Basin



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Objectives

Very recently, the Bolivian government and Advanced Minerals Technology S. Korea, Inc. (AMTSK) created a partnership in which AMTSK will be granted mining rights in Potosi, Bolivia in exchange for using cutting edge technology (provided by its subsidiary company ROC Sciences, Inc.) to clean heavy metal and acid contamination from the Pilcomayo River Basin and provide treatment to people whose health has been negatively impacted by the contamination. For the environmental remediation and treatment, AMTSK will be partnering with Universidad Mayor de San Simón (UMSS), Universidad Autónoma Tomás Frías (UATF), Universidad Técnica de Oruro (UTO), and Hospital de Tercer Nivel Potosi “Fray Giovanni Eugenio Natalini Magnani”.

The contamination of the Pilcomayo River Basin has been researched and documented in the past. However, there is a gap in understanding between the contamination of the river and its effects of the health of the people living in the region. This project will assist AMTSK in its environmental remediation efforts by:

1. Detailing which areas are the most heavily polluted and what pollutants are present.
2. Highlighting which towns, villages, and indigenous communities are most at-risk from the contamination.
3. Compiling scientific and historical documentation, as well as interviews of local stakeholders about the health outcomes of people in these river basin communities.
4. Presenting the available information in a comprehensive and digestible format so that it may be used by AMTSK, policymakers, NGOs, and local communities.

Implications

The Pilcomayo River Basin covers an area of 292,000 km², connecting Bolivia, Argentina, and Paraguay. This series of rivers serves as an important source of agricultural water for Bolivian, Argentinian, and Paraguayan communities. Additionally, indigenous communities in the area rely on the Pilcomayo for drinking water and fishing. In totality, “The Basin is home to an estimated 1.5 million people.”ⁱ Over the past 450 years, the Pilcomayo River Basin has been consistently polluted with mining waste products (heavy metals and acids) from the Potosi region. Extremely high concentrations of Arsenic (As), Antimony (Sb), Cadmium (Cd), Lead (Pb), Silver (Ag), Mercury (Hg), Thallium (Tl), and other heavy metals have been measured in upstream areas of the Pilcomayo River.ⁱⁱ Additionally, there is some evidence that some of these hazardous materials have leaked into groundwater and aquifers.

Exposure to heavy metals can cause a number of physical ailments such as kidney and liver damage, anemia, brain damage, and arrhythmia.ⁱⁱⁱ They pose an even greater risk to pregnant women and children, potentially causing miscarriage, congenital diseases, and developmental delays. While there have been some studies on the human health outcomes of the Pilcomayo region, they are piecemeal and scattered across many sources. Due to this, there are no official estimates of how many people are affected by the contamination or to what degree the contamination affects them. There could be anywhere from a thousand to tens of thousands of people (or more!) currently afflicted with contamination-induced health ailments. Given the long history of pollution, it would not be a stretch to say that this is a generation-spanning issue. It is impossible to know how many people in the past were impacted, however, by acting now, we have the chance to help ensure that future generations have the opportunity to live healthy lives.

ATMSK seeks to tackle the contamination issue on two fronts: environmental remediation and treatment of afflicted individuals. However, being the first organization in history to attempt to clean the Pilcomayo, ATMSK faces a serious issue. They do not have a clear picture of the specifics or the scope of the environmental and human health damages. To solve any problem, one must first understand it in as much detail as possible – and that is why this project is necessary. Our ability to compile as much of the existing information as possible and present in a digestible format will give ATMSK and the Bolivian government much needed guidance in their remediation efforts.

Equity

This history of Potosi and the Pilcomayo is a history of inequity. The first to mine in Potosi were the Spanish conquistadores, who discovered a massive silver deposit in 1545. Dubbed “Cerro Rico”, the mountain provided an abundance of silver and other precious metals which became the core of the Spanish Empire’s vast wealth.^{iv} The Spanish forced the local indigenous peoples to work the dangerous mines while they reaped the profits. Although the people of Bolivia eventually overthrew their Spanish oppressors, the hierarchies of the mining system persist even to the present day. Despite the vast riches of “Cerro Rico”, the people of the Pilcomayo River Basin are relatively poor, with 60% living below the poverty line.ⁱ While Bolivian and international corporations reap the profits of Potosi’s mineral wealth, the people of the Pilcomayo Basin are left with contaminated water and little else.

This unequal dynamic disproportionately affects the indigenous peoples of the region. To this day, a large portion (if not most) of the mine workers have indigenous roots, and roughly a quarter of the population of the river basin is indigenous. These communities are the most reliant on the Pilcomayo river, using it for drinking water and fishing. As such, that they are the most directly affected by the contamination.ⁱ Our project seeks to give a voice to the long-overlooked communities of the Pilcomayo River Basin. By presenting their struggle using data, we can help establish a greater degree of “credibility” to their long-standing complaints about the river contamination. In the best case, our project could be used to highlight the communities of this region as an urgent target for domestic and international aid.

Available Data

This project will make use of the following provided by Universidad Mayor de San Simón (UMSS), Universidad Autónoma Tomás Frías (UATF), and Universidad Técnica de Oruro (UTO).

- Water quality sampling data from the Pilcomayo Basin.
- Human health surveys, studies, and research papers.
- Demographic studies and studies on the migration of local indigenous peoples of the Pilcomayo Basin.

This project will also make use of publicly available geographic and demographic information of the Pilcomayo Basin.

In addition, ATMSK will be collecting its own data over the course of the project, which we will be given access to as it's collected:

- Water quality sampling data from the Pilcomayo River
- Labs and physical examinations performed by Hospital de Tercer Nivel Potosi "Fray Giovanni Eugenio Natalini Magnani" on subsamples of the populations of communities in the Pilcomayo Basin

Possible Approaches

- Produce a GIS product to demarcate regions where contamination is the greatest and which contaminants are present in each region.
- Produce a GIS product showing which town, cities, and indigenous tribes lay along the path of the Pilcomayo River, as well as how each community uses the river's water.
- Produce an environmental risk assessment map using GIS by comparing contamination data with anthropological, demographic, and water use data.
- Conduct a scientific literature review of research performed by [] University and [] University and compile the information into a digestible format.
- Conduct a literature review of historical documents pertaining to the mining activities of Potosi and their effects on the indigenous and other communities of the Pilcomayo Basin.
- Interview community members and key stakeholders of the Pilcomayo River Basin to understand how people in the region perceive the issue of water contamination.

Deliverables

In addition to the final written report, poster, and oral presentation, deliverables may include:

- One or more GIS products identifying: regions of high contamination, the contaminants present in each region, the location and demographics of communities in the river basin, the water use habits of communities in the river basin, and/or the human health risk of each region
- White paper document outlining the historical, current, and future impacts of the heavy metal contamination of the Pilcomayo River Basin containing: scientific literature, case studies, anecdotes, interviews, and historical texts.
- An environmental risk assessment document detailing the contaminants and level of contamination present in different regions of the Pilcomayo River Basin, the potential human health effects of the contamination, and recommended actions for ameliorating the risks to human health.

Works Cited

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Advanced Mineral Technology South Korea Inc.

January 3, 2025

To: Group Project Committee, Bren School of Environmental Science & Management, University of California, Santa Barbara

From: Jeff Thoreson, International CEO, Advanced Minerals Technology South Korea, Inc. (AMTSK)

Re: Letter of Support for Bren Group Project with AMTSK

Advanced Minerals Technology South Korea, Inc. (AMTSK) is honored to express our enthusiastic support for the proposed student group project, “Addressing Centuries of Heavy Metal Pollution: Understanding the Human Health Crisis of the Pilcomayo River Basin.” This project directly aligns with our mission to leverage cutting-edge technologies, including those of our subsidiary ROC Sciences, to advance environmental remediation, sustainability, and community health. The Pilcomayo River Basin is in critical need of focused research and action to address over 450 years of pollution from mining activities, and we believe this collaboration will provide essential insights and actionable solutions.

AMTSK is committed to providing the necessary coordination, guidance, and support to ensure the project’s success. Specifically, we will:

- Provide timely access to available data, including historical contamination information, proprietary methodologies for remediation, and environmental sampling from ongoing efforts in the Pilcomayo region. While most data will be shared without restriction, we may require a non-disclosure agreement for select proprietary technologies to safeguard intellectual property.
- Historical and current contamination data from the Pilcomayo River Basin, including water and soil samples previously collected in the region.
- Access to our proprietary environmental remediation data and methodologies for addressing heavy metal contamination.
- On-the-ground support in Bolivia, including facilitation of logistics and local introductions to communities, policymakers, and NGOs.
- Contribute additional project funding of \$15,000, supplementing Bren School resources, to support fieldwork, data analysis, and community engagement activities.
- Offer two paid internships for Bren School students, with each intern receiving \$8,000 to cover travel, living expenses, and professional engagement. Interns will work closely with AMTSK scientists and engineers, gaining practical experience in environmental remediation and sustainability practices. These internships will focus on developing

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Advanced Mineral Technology South Korea Inc.

maps of contamination hotspots, identifying communities most at risk, and compiling critical health data to inform remediation strategies.

AMTSK's efforts in Bolivia represent a landmark initiative to address the environmental and human health impacts of heavy metal contamination. The Pilcomayo River Basin, home to 1.5 million people, has suffered decades of neglect, leaving communities vulnerable to significant health risks. This project will support our dual objectives of remediating the basin and providing care for affected individuals. Furthermore, AMTSK is committed to transparency and will share the data gathered during this project to foster broader understanding and collaboration for future solutions.

We are proud to partner with Bren School graduate students to tackle this pressing issue. Please do not hesitate to reach out with any questions regarding our support, internships, or the project proposal. Thank you for considering AMTSK as a client, and we look forward to working together to create impactful change.

Best regards,

Jeff Thoreson
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