Trip Report: **Blacksmith Institute Site Visit**
Doe Run Peru (DRP) Metallurgical Facility
La Oroya, Peru
May 2008

Prepared by: **Ian von Lindern, P.E., PhD**
International Environmental Health and Restoration Initiative
TerraGraphics Environmental Engineering /
University of Idaho, Moscow, Idaho USA

Synopsis

The Blacksmith Institute listed La Oroya as one of the Top Ten Most Polluted Sites in the world in 2006 and 2007 due to the high incidence of childhood lead poisoning and risk of respiratory disease in the community. Subsequently, Blacksmith was invited to La Oroya by Doe Run Peru (DRP) representatives in May 2008 to observe emission reduction and community health intervention efforts underway to address those problems. The Blacksmith team included Blacksmith personnel and representatives of industry, academia and private consultants with extensive experience in mining/smelting cleanup programs. The team reviewed existing reports and met with representatives of Non Government Organizations (NGOs), the Peruvian national government, DRP, the Catholic Church, and local health officials from the Peruvian Ministry of Health (MINSA); and conducted independent sampling and reconnaissance of the area.

Review of the existing data indicated that serious health problems had prevailed in La Oroya since, at least, the 1990's. Mean blood lead levels were near 40 ug/dl for young children in the most exposed areas of the city. The majority of children throughout La Oroya have exhibited blood lead concentrations exceeding recommended levels (10 ug/dl) for the last decade. Both ambient air lead and SO2 concentrations increased in 2005-06, nearly doubling 2003-04 levels in the community. DRP has recently undertaken a substantial investment in environmental improvements within the metallurgical complex and in the community. The improvements within the complex are known under the acronym PAMA. An independent Expert Committee reviewed the PAMA program in 2006 and concluded that PAMA will improve the situation, but will likely not be sufficient to fully alleviate health concerns in La Oroya.

Significant progress in reducing children's blood lead levels and environmental exposures has been accomplished since the 2006 Experts Comments report. Substantial investment in emission and effluent controls, more responsible operating practices and protocols, and exposure reductions have occurred and should be recognized. DRP has completed several PAMA projects and instituted significant industrial hygiene efforts within the facility; and is sponsoring a comprehensive public health intervention program for children identified with severe blood lead levels.

However, given the terrain, meteorological and socio-economic challenges, proximity of poor families to the immediate area of the complex, and the legacy contamination from

historic operations; reducing blood lead levels to acceptable criteria remains difficult. There are concerns as to whether the air quality health criteria are appropriately protective, and whether the emission reductions achieved are sufficient and sustainable. There is a need to remediate legacy contamination in soils, dusts and structures in the community ("pasivos ambientales"). Public health intervention programs should continue indefinitely until permanent exposure reductions are achieved.

The Experts Comments 2006 conclusion that blood lead levels will decrease significantly, but not sufficiently, at the completion of PAMA continues to apply. It is important that children's blood lead levels continue to be tested and that environmental exposure be concurrently monitored. As recommended in a 2005 review by the U.S. Public Health Service, these results should be examined comprehensively through scientifically robust studies. Blood lead/dose-response analyses should be conducted to determine those sources and exposure co-factors most influencing lead absorption; and the effectiveness of the emission reduction, remediation, abatement, and health intervention activities. These findings will help to identify those additional measures that will be required to permanently reduce children's blood lead concentrations to safe levels.

Biography / Affiliation of Ian von Lindern

I am an Owner and Chief Executive of TerraGraphics Environmental Engineering (TG) in Moscow, Idaho USA (www.terragraphics.com). TG is a small northwestern U.S. environmental science and engineering consulting firm that specializes in hazardous waste cleanup and environmental restoration. TG's primary client base is local, state and tribal governments. We currently have operations in both the western U.S and British Columbia in Canada.

I am a founder of TG and have 35 years of experience in the environmental health, science and engineering. I have been Project Manager for several large multi-disciplinary projects over those years. The majority of these projects have involved the mining, smelting and mineral refining industry. I have visited numerous hazardous waste and operational sites, both nationally and internationally, representing governments, communities and individuals involved in regulation, negotiation or litigation with these facilities.

The largest of those Projects has been the Bunker Hill Metallurgical Complex / Coeur d'Alene Basin Superfund Site Cleanup in Idaho, U.S., where we have provided site characterization, risk assessment, cleanup strategy and planning, design, and construction oversight for several hundred million dollars of investigation and cleanup of this former lead/zinc/silver mining and smelting site. My individual expertise is human health risk assessment and childhood lead poisoning. I conducted and coordinated most of the human health risk assessment and response activities undertaken in the Coeur d'Alene Basin (also known in the literature as Bunker Hill, Silver Valley or Smelterville) for the last 34 years. Over that time, mean pre-school blood lead levels have been reduced from near 70 ug/dl to 2 ug/dl today. Since 1988, several years after smelter closure, the

incidence of children with blood lead levels exceeding 10 ug/dl were reduced (through a combination of health intervention and remediation activities), from >75% to 2-3% by 2001-02.

I am also a member of the U.S. Environmental Protection Agency's (EPA) Science Advisory Board (SAB) and Clean Air Scientific Advisory Committee (CASAC) for lead. I have been a member of the latter since 1977 and am one of the longest serving members. This committee reviews the development of lead related criteria documents, rules and regulations and provides advice to the EPA Administrator regarding the scientific merit of the Agency's actions. SAB/CASAC's most recent action over the past two years has been review of the National Ambient Air Quality Standard (NAAQS) for lead. That action was pursuant to a lawsuit brought by citizen's groups surrounding the Doe Run primary smelter in Herculaneum, Missouri. Subsequently, the U.S. EPA used the Herculaneum site as the primary smelter pilot study in the NAAQS analyses. As such, I am familiar with the particulars of that situation.

My involvement with Blacksmith Institute is as a member of the Technical Advisory Board that offers scientific and technical advice on a variety of issues. I am also involved with Blacksmith and other NGOs and local governments in undertaking site characterization and cleanup activities in other countries. These include cleanup of a primary lead smelting and mining community in Far East Russia, a secondary lead smelter in the Dominican Republic, and a series of former arsenic smelters in Yunnan Provence, China. In these cases, myself and other colleagues have conducted sampling and other data collection to characterize these sites and the associated risk to human health; worked with local officials to develop risk mitigation strategies; designed cleanups and health intervention programs; and provided oversight and advice to the cleanup activities in cooperation with Blacksmith.

I have performed these functions through the TerraGraphics/University of Idaho ***International Environmental Health and Restoration Initiative***. This Research and Development Initiative is sponsored by TG, and its purpose is to adapt the technologies used and lessons learned in U.S. cleanup projects for application in countries only beginning to address these issues. It was in this capacity that Mr. Dobbin and I visited La Oroya at Blacksmith's invitation. My trip was paid for by TG and Mr. Dobbin was compensated by the University, as part of the initiative. The International Initiative also sponsors students from home countries to assist in adapting and implementing health and response activities in association with local universities.

Materials Reviewed

Prior to visiting La Oroya, I reviewed several publications and reports. Among those I found the following particularly useful in helping to understand the history and status of the situation:

1) La Oroya Cannot Wait. Cederstav, A.K. and Barandiaran, G., Interamerican Association for Environmental Defense (AIDA) and Peruvian Society for Environmental Law (SPDA), 2002.

2) Development of an Integrated Intervention Plan to Reduce Exposure to Lead and Other Contaminants in the Mining Center of La Oroya, Peru. U.S. Centers for Disease Control (CDC), National Center for Environmental Health (NCEH)/ Agency for Toxic Substance and Disease Registry (ATSDR), May 2005.

3) Experts Comments of Exceptional Fulfillment Extension Request for the Sulfuric Acid Plant Project of La Oroya Metallurgical Complex PAMA. Clark, S., Partelpoeg, E., and Young. J., Direccion General de Asuntos Ambientales Mineros, Lima, Peru, May 2006.

These documents provide a summary of historic environmental contaminant concentrations, exposures and blood lead levels; evaluations of the contemporary situation; and recommendations for future action. During our visit to La Oroya, DRP and Peruvian government officials were interviewed in the context of these historic summaries. Briefly, these reports indicated the following with respect children's lead poisoning.

Historic Childhood Lead Poisoning

1) AIDA/SPDA 2002: Children's blood lead levels have been monitored by both the Peruvian health authorities, Dirección General de Salud Ambiental (DIGESA) and Doe Run Peru (DRP) in the past. AIDA/SPDA summarized the DIGESA data from 1999. Those reports indicated blood lead levels of 346 2-10 year old children ranged from 6.9 to 79.9 ug/dl with a mean of 33.6 ug/dl. These levels varied with age and geographic proximity to the smelter as expected. Two to four year old children averaged 38.6 ug/dl and residents of La Oroya Antigua showed average levels of 43.5 ug/dl. Some school zones showed average levels as high as 55 ug/dl. AIDA/SPDA noted that DRP was beginning in 2000 to test blood lead levels in La Oroya children. AIDA/SPDA concludes that the lead poisoning problem is most severe near the smelting facility and is serious in all monitored sectors; and that the entire city is in need of urgent intervention. The AIDA/SPDA report makes several recommendations to various stakeholders as to how to improve the environment and reduce blood lead levels in the community.

2) CDC/ATSDR 2004-05: This 2004-05 evaluation also summarized the same 1999 data in terms of geographic zones extending from the DRP complex and references another study of 30 children conducted by Union for Sustainable Development Consortium (UNES) in 1999, indicating blood lead levels of 15.8 to 64.7 ug/dl with a mean of 41.8 ug/dl. CDC also notes that DRP surveyed 252 0-3 year old children in 2000-01. Mean levels in La Oroya Antigua were 36.7 ug/dl, with corresponding levels of 27.1 ug/dl and 22.8 ug/dl in outlying areas. CDC concluded that the smelting facility in La Oroya is the main source of contamination. CDC noted that no agreement amongst responsible parties had been reached on appropriate emissions reductions or remedial actions as of 2004-5.

CDC also indicated that the geographic distribution of lead and other contaminants in environmental media was not well understood and more information would be required to develop an effective plan to remediate historical contamination. CDC's recommendations follow:

> ***VI. (CDC/ATSDR 2005) RECOMMENDATIONS***
>
> *The most immediate priority is to reduce exposure to lead and other contaminants. This is best accomplished by building the environmental public health infrastructure needed to develop and implement a comprehensive and integrated intervention plan. Stakeholders must unite and work together systematically to reduce emissions, remediate soil contamination, and operate a sustainable monitoring system. Specifically, the process should address the following areas:*
>
> *1. Reduce air lead emissions, both stack and fugitive, to levels that protect children from having BLLs ≥10 μg/dL. Until this is accomplished, no other interventions will have a great impact on lowering children's BLLs.*
>
> *2. Implement interventions demonstrated scientifically to reduce lead exposure from historical soil contamination.*
>
> *3. Develop a scientifically robust plan to monitor the impact of emission reduction efforts.*
>
> *To strengthen the overall process and plan, and to improve credibility and ensure that monitoring and other needs of affected parties are met, stakeholders should participate in reduction planning, implementation, and monitoring not only of lead, but also of other contaminants as well.*

3) Experts Comments 2006: This group was asked to provide a third party opinion regarding DRP's PAMA Extension Request for implementing agreed upon environmental controls at the smelter complex. With regard to blood lead levels and lead exposures the panel concluded that:

> *The very high blood lead levels of children in the La Oroya area and the very high air and dust lead levels that have been reported are evidence that a severe health problem exists. This problem has been evident for several years and was undoubtedly in existence for many years in the past. The behavioral and cognitive results of exposures at the levels in the La Oroya area have been documented in a number of carefully designed and executed studies.*

This report did not, however, summarize any additional blood lead testing and was apparently referencing the same data discussed above. The Experts Comments report did reference additional dust data that had been collected by the *Association Civil Labor and Occupational Knowledge International*, in a report entitled "Interior Dust Lead Levels in

La Oroya, Peru", October 2004. Most of the lead health discussion in the Expert's Comments regarded the environmental media exposures and noted the lack of representative data to appropriately assess the situation and to develop effective remediation strategies. The lack of objective information regarding soil and dust lead levels throughout the area, the assumptions being made about the bioavailability of these media, and the application of inappropriate blood lead exposure models were also noted as hindering identification of the critical lead poisoning pathways for La Oroya children. Among the more significant findings is the following:

4.2 PAMA EXTENSION / LA OROYA PROBLEM RESOLUTION

It is the opinion of the panel that granting the PAMA extension and implementing the DRP process improvement programs will not, by themselves be sufficient to resolve the La Oroya region community health problems. That being said, the ongoing program to decrease fugitive emissions from the smelter is an important step towards long term resolution of the lead issues and the installation of the lead and copper circuit acid plants will be a significant move towards reducing SO_2 levels in the community. Some immediate efforts need to be made to protect the health of children already having dangerously elevated blood lead levels, such as through the provision of temporary lead-safe housing, and to minimize the likelihood of other children who reach such levels in the future.

As in most major undertakings of this type, there is a need for continuous improvement and review. This is especially true in La Oroya as a result of the over 80 years of uncontrolled emissions creating heavy metal reservoirs throughout the study area.

May 2008 Blacksmith Visit

The Blacksmith Institute team was invited to La Oroya by DRP representatives following the site's designation on the Blacksmith's Top Ten Polluted Sites in 2006 and 2007 (www.blacksmithinstitute.org). The site was nominated and selected due to the high incidence of childhood lead poisoning and respiratory disease risk apparent in the community. The team consisted of Richard Fuller of Blacksmith, Jack Caravonos of Hunter College, Brian Wilson of the International Lead Management Center (ILMC) and Ian von Lindern and Denny Dobbin of TerraGraphics Environmental Engineering/University of Idaho. During the team's visit to Peru in May of 2008, we met with representatives of NGOs, Activos Mineros of the Peruvian national government, and Doe Run Peru (DRP) while in Lima. In La Oroya we toured the DRP facility, observed street cleaning operations in La Oroya Antigua, toured the daycare facility at the

Casaracra Children's Nursery, met with Catholic Church representatives and observed the food supplement program, met with local health officials from the Peruvian Ministry of Health (MINSA) coordinating the Convenio MINSA-GRJ-DRP health intervention program, and conducted independent sampling and reconnaissance of the area.

As team members we divided interview responsibilities and consulted with other groups independently during our visit, so our findings may differ in that regard. Brian Wilson has submitted a trip report entitled *Site Visit to the Doe Run La Oroya Metallurgical Complex, Control of Process and Fugitive Emissions in the Plant and the Community*, posted on the Blacksmith website. Brian Wilson's report represents his own views and impressions of the visit. The other team members were not involved in developing the ILMC report. I believe the report is an accurate and fair summary of the presentations and demonstrations that DRP arranged for the team and does a good job of documenting the investments and expenditures DRP has undertaken in PAMA and other environmental improvement and intervention efforts in La Oroya.

During our visit to La Oroya, Dr. Jesus Diaz Matos, the Coordinator General of the Convenio MINSA-GR JUNIN-DRP, was interviewed and provided the latest blood lead and environmental exposure information collected under the joint DRP/Government project. Blood lead levels have been monitored under this program since 2004. This program also coordinates and reports on environmental media monitoring results and operates the lead health intervention program that provides off-site health, nutrition and day care services to high blood lead level children. The Program is paid for by DRP at a cost, reportedly, exceeding U.S. $1M per year.

Historic blood lead level survey results from this program were summarized as follows:

The Tables and Charts in Figure 1 indicate that from 793 to 1171, 0-9 year old, children have been tested annually since 2004. Most of these children were in the 0-6 year age range. Mean blood levels in these groups were near 30 ug/dl through November 2006, and were consistent with the mean blood lead levels indicated in the 1999-2002 surveys (34 ug/dl). Mean blood lead levels decreased to near 20 ug/dl (about a 30% decrease in all age groups) by May 2007.

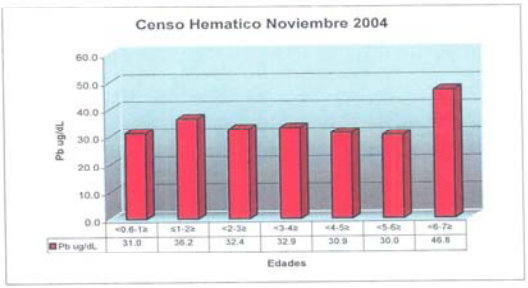
Figure 2 indicates that these children come from four geographic areas: La Oroya Antigua, Paccha, Huari, and La Oroya Nueva. Highest levels were observed in La Oroya Antigua as noted previously and averaged 32-35 ug/dl through 2006 and dropped to near 20 ug/dl in November 2007. Pacca children exhibited a mean near 17 ug/dl that dropped to near 13 ug/dl in 2007. Intermediate levels and similar reductions were noted in the other communities. Cursory examination of these data indicates that blood lead levels throughout La Oroya were largely unchanged from 1999 through 2006 and a significant decrease in exposure occurred among children tested between November 2006 and November 2007.

Figures 3 and 4 show sentinel children's blood lead results (i.e. the same children tested in successive surveys). These data indicate mean blood lead levels for these children were

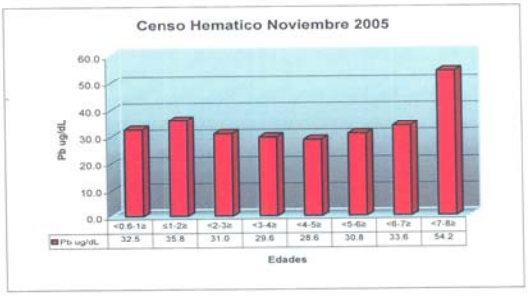
39-41 ug/dl and largely unchanged from November 2004 to May 2006, then decreased by about 15% to 33-35 ug/dl in May 2007, and dropped to 23 ug/dl by November 2007. A simplistic review of this graph indicates a 40% drop in blood lead from 2004 to the most current readings, with most of that reduction coming between May 2007 and November 2007. Review of the summary data for sentinel children indicates a similar reduction in exposure occurred in 2007.

Figure 1. Blood Lead Levels by Age Group 2004-2007.

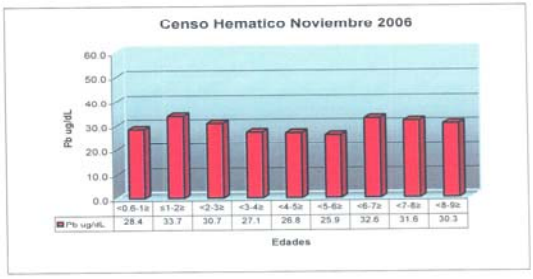
Nov-04	Niños	Min	Max	Prom Pb
<0.6-1≥	77	11.8	54.9	31.0
≤1-2≥	133	9.4	73.3	36.2
<2-3≥	127	13.2	70.0	32.4
<3-4≥	121	13.5	76.1	32.9
<4-5≥	149	12.0	52.2	30.9
<5-6≥	184	13.2	63.5	30.0
<6-7≥	2	43.3	50.2	46.8
Total	793			



Nov-05	Niños	Min	Max	Prom Pb
<0.6-1≥	94	5.1	77.6	32.5
≤1-2≥	198	9.3	91.1	35.8
<2-3≥	163	5.5	65.8	31.0
<3-4≥	193	6.1	70.1	29.6
<4-5≥	156	6.0	49.5	28.6
<5-6≥	186	9.9	57.9	30.8
<6-7≥	104	13.9	54.2	33.6
<7-8≥	1	54.2	54.2	54.2
Total	1095			



Nov-06	Niños	Min	Max	Prom Pb
<0.6-1≥	93	4.9	64.7	28.4
≤1-2≥	213	6.7	78.5	33.7
<2-3≥	214	7.9	86.6	30.7
<3-4≥	215	5.3	57.6	27.1
<4-5≥	220	5.3	60.0	26.8
<5-6≥	159	4.9	56.2	25.9
<6-7≥	30	8.1	50.2	32.6
<7-8≥	25	13.9	48.1	31.6
<8-9≥	2	27.4	33.2	30.3
Total	1171			



Mar-07	Niños	Min	Max	Prom Pb
<0.6-1≥	90	5.0	45.8	19.1
≤1-2≥	203	3.3	54.6	23.2
<2-3≥	200	5.3	50.5	20.6
<3-4≥	176	4.1	46.2	20.1
<4-5≥	165	3.1	38.8	18.0
<5-6≥	182	5.6	41.8	17.7
<6-7≥	0	0.0	0.0	0.0
<7-8≥	0	0.0	0.0	0.0
<8-9≥	0	0.0	0.0	0.0
Total	1016			

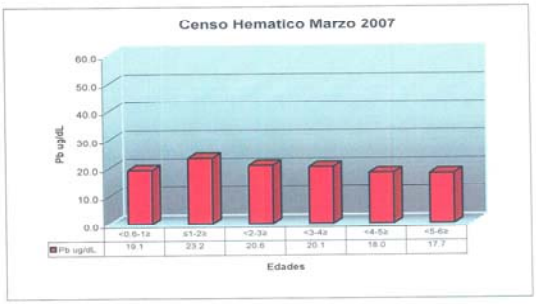


Figure 2. Blood Lead Levels by Geographic Area 2004-2007.

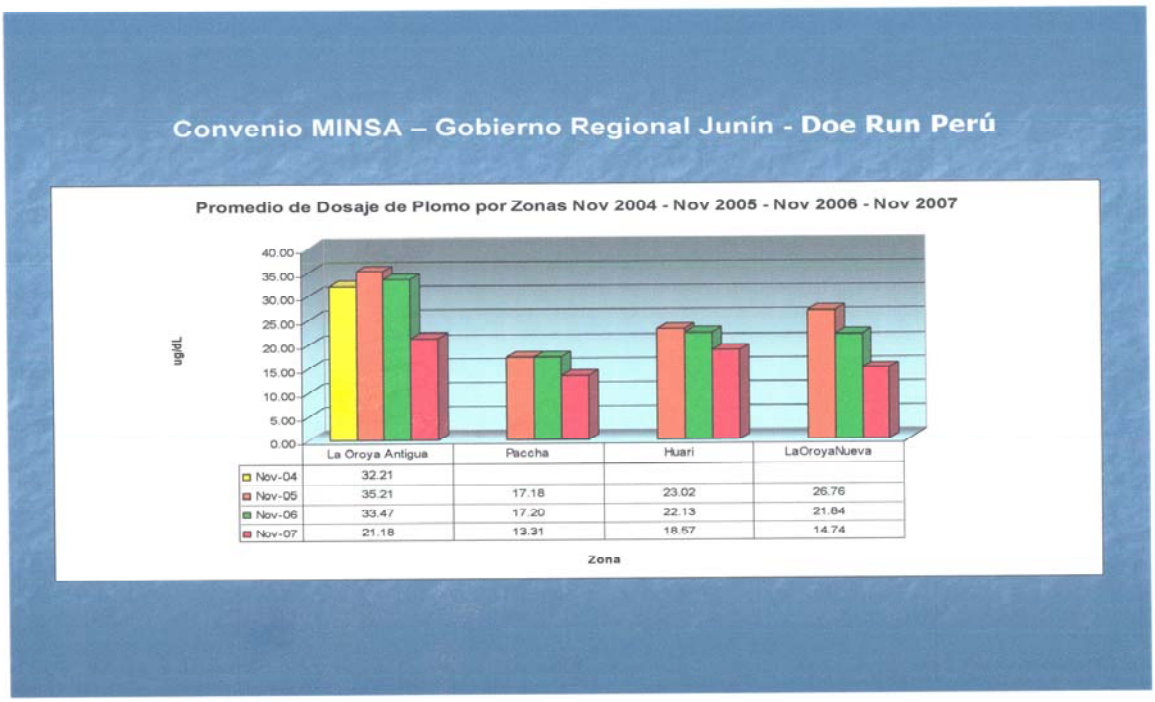


Figure 3. Blood Lead Levels for Sentinel Children 2004-2007

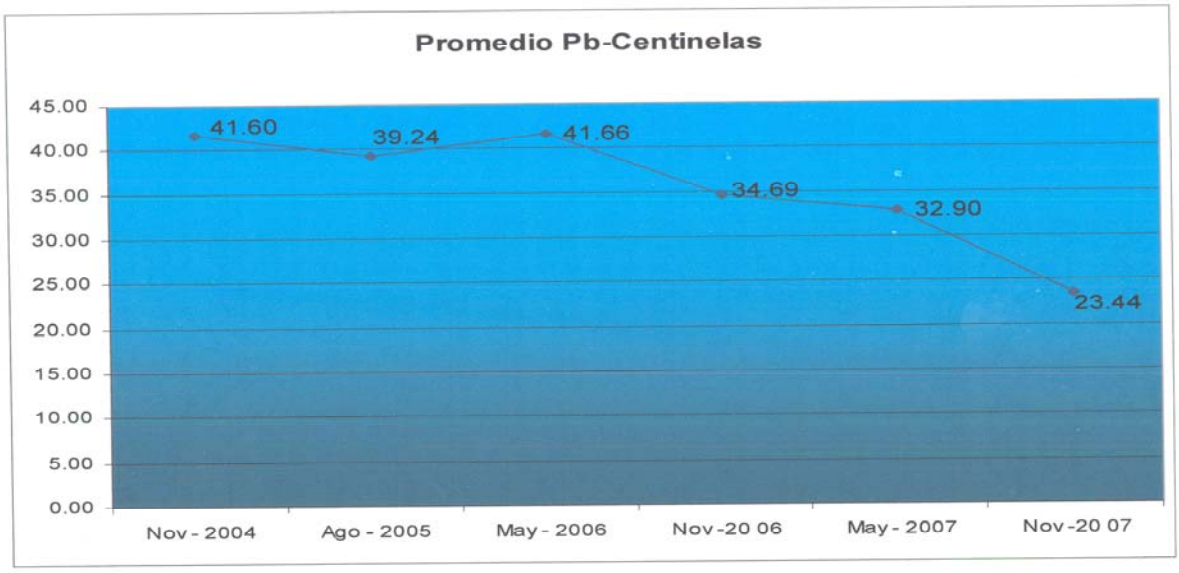


Figure 4. Tabular Blood Lead Levels for Sentinel Children by Age 2004-2007

Variación de niveles de Plomo en Centinelas.

EDAD	Nov - 04	Ago- 05	May - 06	Nov - 06	May - 07	Nov - 07
0 - 1	40.62					
1 - 2	45.24	42.04	38.55			
2 - 3	43.42	44.50	43.99	37.30	24.25	
3 - 4	42.81	41.03	44.51	37.19	33.99	22.54
4 - 5	34.95	35.59	44.95	34.81	34.19	23.78
5 - 6	37.57	34.02	36.09	34.64	35.50	21.56
6 - 7	50.20	34.87	36.63	32.01	30.02	25.92
7 - 8		43.60	37.04	29.75	31.34	26.57
8 - 9				35.11	31.52	21.98
9 - 10					37.24	26.43

The reduction in blood lead levels noted in 2007 is, seemingly, the first step in actually reducing exposure and blood lead levels in La Oroya, and should be regarded as good news. However, it is unfortunate that little relief was offered to these children between 1999, when the problem was clearly identified, and 2007. As indicated in the Experts Comments review in 2006, these reductions, although positive and encouraging in the short-term, are likely insufficient to adequately reduce health risk to children in these communities. Additionally, it is not clear which specific events triggered these reductions, whether the reductions are permanent and sustainable, and whether safe blood lead levels will be achieved without substantially greater remediation and intervention efforts.

These difficult and critical questions will not be answered without a better understanding and quantification of the pathways of childhood lead poisoning in La Oroya. This conclusion is similar to that reached by CDC in 2005 and amplified in the Experts Comments review a year later. There has, however, been some progress in beginning to collect the fundamental data needed to address these questions.

Environmental Lead Exposure and Media Concentrations

Dr. Diaz Matos, Cordinador del Convenio MINSA-GRJ-DRP, summarized these environmental data in a 13 de Marzo del 2008 memorandum entitled INFORME AMBIENTAL 2007. Some of that memorandum is reproduced and discussed below.

Figure 5 below shows air lead data provided. These data indicate that annual air lead mean concentrations at the DIGESA Sindicato Station were observed at 2.6 to 2.9 ug/m3 from 2002-04 and then increased to 4 to 5 ug/m3 in 2005-06, followed by a decrease to less than 2 ug/m3 in 2007. The second graph shows details for 2007 indicating the levels decreased below the 1.5 ug/m3 health standard in April and for the remainder of the year. Figure 6 shows data for other stations, presumably operated by DRP, for 2007. These stations all show levels below the 1.5 ug/m3 ECA mensual indicated after March of 2007.

Other data provided in the memorandum included lead in food, and interior and exterior dust. The lead in food data show inconsistent results when comparing 2006 and 2007 levels. Dust lead levels indicate a possible decrease in lead concentrations from 2005 to 2007 . Similar to the blood lead data, all of these measurements indicate a positive trend in reducing exposures underway by 2007 and it is encouraging that data are beginning to be collected to appropriately characterize the situation.

Summary of the Current Situation

Exposure and Blood Lead Reductions

The AIDA/SPDA report concluded that dangerous blood lead levels existed among children throughout the La Oroya community in 1999, the DRP complex was the primary source of children's lead poisoning, and emission reductions and health intervention were needed to reduce those levels. The CDC/ATSDR report in 2004-05 echoed those concerns and recommended that actions be taken by all stakeholders to reduce blood lead levels to <10 ug/dl for all of the La Oroya's children. CDC/ATSDR concluded that both reductions in current emissions from the complex and remediation of legacy contamination in the soils, dusts and homes of La Oroya would be required to accomplish that goal. The Experts Comments report in 2006 reaffirmed those concerns and goals, but indicated the PAMA improvements alone would not be sufficient to resolve the health concerns associated with lead poisoning in La Oroya. The latter report was critical of the data base that had been assembled and indicated that more information needed to be collected and responsibly analyzed to characterize the environmental pathways in children's lead poisoning.

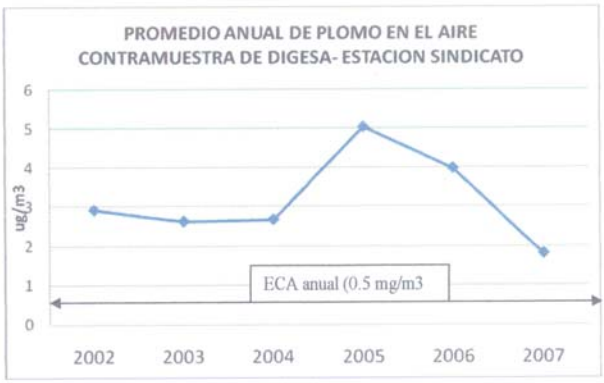
Figure 5 Ambient Air Lead Concentrations 2002-2007

a. Calidad del Aire.

PROMEDIO ANUAL DE PLOMO EN EL AIRE
CONTRAMUESTRA DE DIGESA - ESTACION SINDICATO

AÑO	2002	2003	2004	2005	2006	2007
Pb (ug/m3)	2.918	2.63	2.675	5.04	3.99	1.8
ECA anual	0.5	0.5	0.5	0.5	0.5	0.5

FUENTE: DIGESA



PROMEDIO MENSUAL DE PLOMO EN EL AIRE
CONTRAMUENTRA DE DIGESA - ESTACION SIDICATO - 2007.

MES	DIC	ENE	FEB	MAR	ABR	MAY	JUN	JUL	AGO	SET	OCT	NOV	Prom. Anual
Pb (ug/m3)	3.9	3.3	2.51	3.26	1.45	1.1	1.31	1.1	0.7	0.9	1	1.1	1.8
ECA mensual	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	

FUENTE: DIGESA

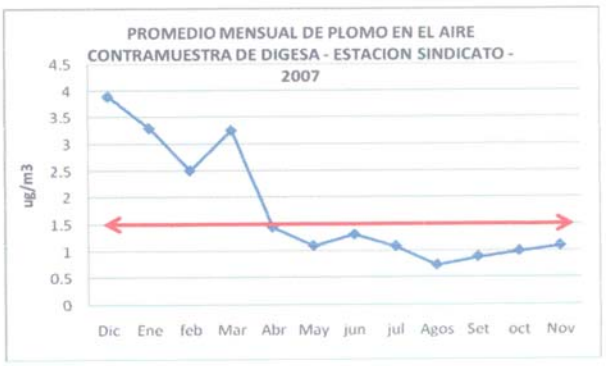
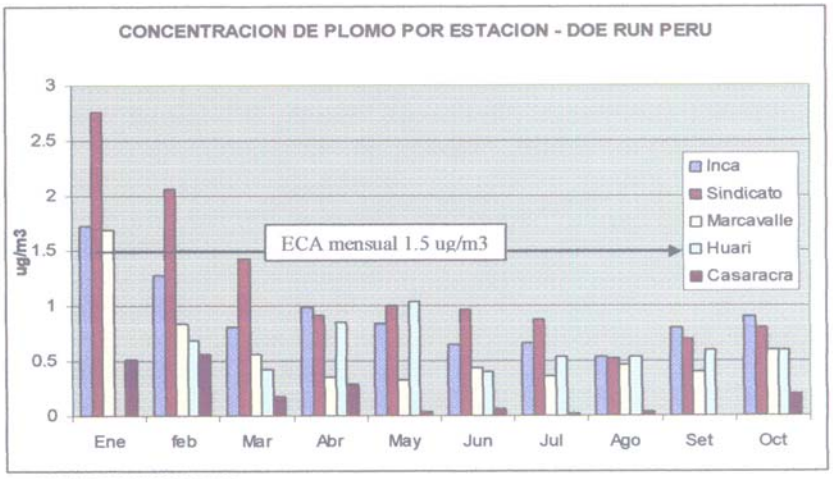


Figure 6 Air Lead Levels by Station 2007and Annual SO2 Concentrarions 2002-07

CONCENTRACIÓN DE PLOMO POR ESTACIONES 2007 POR DOE RUN PERU



FUENTE: DOE RUN PERU

PROMEDIO ANUAL DE SO2 EN EL AIRE
ESTACION SIDICATO - DOE RUN PERU

AÑO	2002	2003	2004	2005	2006	2007
SO2 (ug/m3)		431.44	460.95	491.24	571.94	706.74
ECA anual	80	80	80	80	80	80

FUENTE: DOE RUN PERU

Significant progress in reducing children's blood lead levels and environmental exposures has been accomplished since the 2006 Experts Comments report. Substantial investment in emission and effluent controls, more responsible operating practices and protocols, and exposure reductions have occurred and should be recognized. DRP has completed several PAMA projects and instituted significant industrial hygiene efforts within the facility and the community. The bulk of PAMA improvements are on schedule for completion by the late 2008 / early 2009. These are expected to accrue additional environmental benefits. An impressive health intervention effort is underway with children exhibiting the highest blood lead levels in recent surveys. Sixteen children with levels exceeding 70 ug/dl received hospitalization and medical treatment in Lima, About 100 children exhibiting blood lead levels > 40 ug/dl are being provided clean daycare, nutritional supplements and learning resources. This program is expected to recruit additional children at successively lower blood lead levels as the PAMA work is completed and community cleanup commences. Brian Wilson's trip report provides a summary of those activities as presented to the Blacksmith team by DRP officials.

It is in my opinion that there has been significant progress in reducing exposures and a positive prognosis for additional improvement. This has been accomplished through a combination of permanent and sanitary control in the smelter, fugitive dust control measures in the community, attention to housing and hygiene factors in the community, and health intervention and treatment efforts. Some of these efforts have been extra-ordinary. The Casarcara Nursery daycare program is unlike any other I'm aware of anywhere in the world. Other controls should have been implemented years ago. The technologies being employed to reduce sulfur oxide emissions were available and required in the U.S. in the 1970s. Both lead and SO2 levels in ambient air decrease nearly doubled in 2005-06 from 2002-04 levels. In 2007, air lead concentrations dropped markedly and showed a nearly 70% decrease from 1997 levels. There is a positive prognosis for additional pollution control through technological improvements at the complex.

However, given the terrain, meteorological and socio-economic challenges, proximity of poor families to the immediate area of the complex, and the legacy contamination from historic operations; reducing blood lead levels to acceptable criteria remains difficult. There are concerns as to whether the air quality health criteria are appropriately protective, and whether the emission reductions achieved are sufficient and sustainable. There is likely a need to remediate legacy contamination in soils, dusts and structures in the community, or "pasivos ambientales"; and public health intervention programs should continue indefinitely until permanent exposure reductions are achieved. Air lead levels well below the 1.5 ug/m3 health standard indicated will be necessary to bring blood lead to <10 ug/dl. That air standard was originally adopted in the U.S. in the 1970's to prevent blood lead levels from exceeding 25 ug/dl. The current U.S. SAB recommendation is to reduce air lead levels to below 0.2 ug/m3 to achieve blood lead levels well below 10 ug/dl. This recommendation pre-supposes typical U.S. dietary, soil and dust exposures that are well below those likely among La Oroya children, not to mention socio-economic and nutritional status differences.

Many of the pollution reduction measures currently exercised at the complex are not strictly "permanent" control. These activities rely on *supplemental* efforts, e.g. curtailing equipment, operating water and sweeper trucks, supervisory vigilance etc., that unfortunately could be neglected under less opportunistic metal prices or new management regimes focused on production. The health intervention and community cleaning efforts are also supplemental and should be considered interim until the pollution sources are permanently minimized. There should be concern as to whether DRP will continue these efforts at the current level of effort and vigilance after the PAMA certification, or when metals prices fall.

Prognosis for Additional Exposure Reductions

I continue to agree with the Experts Comments 2006 conclusion that blood lead levels will decrease significantly, but not sufficiently, at the completion of PAMA. It is important that children's blood lead levels continue to be tested and that environmental exposure be concurrently monitored. These results should be examined comprehensively through blood lead/dose-response analyses to determine those sources and exposure co-factors most influencing lead absorption; and the effectiveness of the emission reduction, remediation, abatement, and health intervention activities. This conclusion agrees with the CDC/ATSDR 2005 recommendations.

There has been a substantial reduction in lead absorption among both the general population and in sentinel children tested in 2007. This represents the first decline in blood lead levels observed in La Oroya in a decade of testing; and is, likely, due to a combination of efforts to reduce exposures throughout the community. These efforts can be discussed in three broad categories:

Emission Reductions:

- permanent reductions in emissions due to installation of new pollution control equipment and metallurgical processes (PAMA);

- emission reductions due to added sanitary and hygiene practices in the smelter;

Remediation and Abatement:

- community soil and dust control efforts;

- improvements in housing;

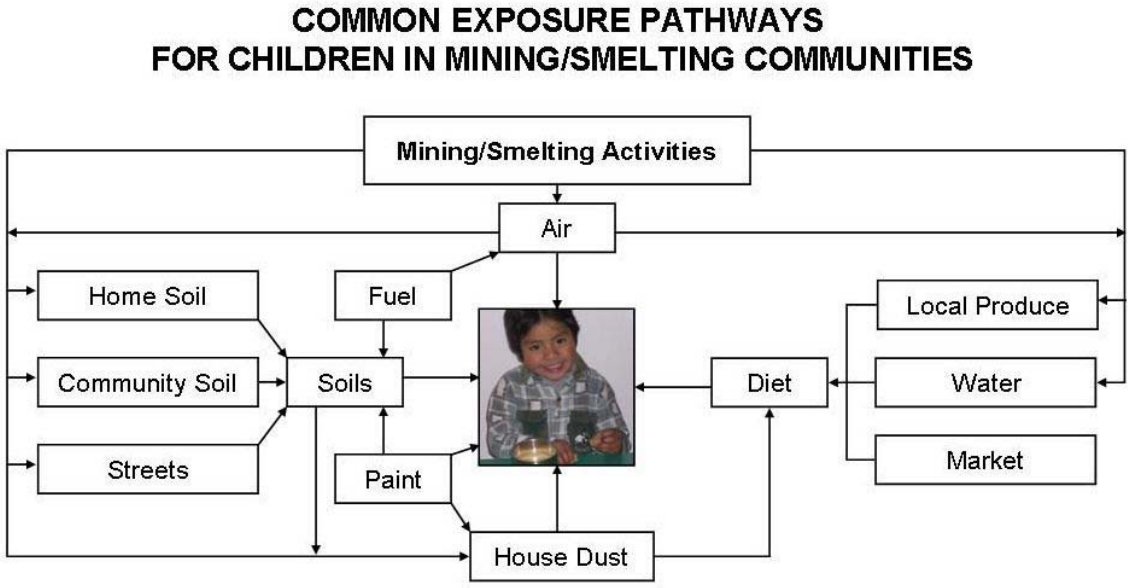
Public Health Intervention:

- education and awareness programs among the population; and

- intervening with high lead children identified though blood lead monitoring programs.

The relative significance of these efforts can also be discussed in the context of the pathways of childhood lead poisoning such as those shown in Figure 7. Children in mining and smelting communities like La Oroya are exposed to a variety of lead sources in their environment. Children intake lead from the environmental media they contact in their everyday lives. These include the air they breathe, food and water they consume, and non-food items they ingest. The latter includes incidental ingestion of soil and dust particles encountered in their home and play environments. These dusts and soil particles are usually the major exposure route in smelter communities. The primary sources of lead to the environment are the minerals industry sources, and to a limited extent, housing and consumer goods. These primary sources either directly, or indirectly, contaminate the environmental media that children contact.

Figure 7. Example Exposure Pathways of Environmental Lead Poisoning in Mining/Smelting Communities



The various measures undertaken in the last eighteen months in La Oroya have effected reductions in lead intake along these various routes. However, it is not well understood which routes were most affected; and there has been little effort, to date, to quantify these pathways. It will be important to accurately quantify the various pathways of lead contributing to childhood intake in La Oroya. The reductions achieved to date, and those likely to result from completion of the PAMA, are likely insufficient to adequately protect children's health.

At the industrial complex, additional emission reductions may be required and continued vigilance and adherence to the sanitary and hygiene controls will be mandatory. Outside the complex, street sweeping and washing should continue until dust lead levels reach acceptable concentrations. Remediation of lead reservoirs in soils and structures in the

community will likely be necessary. These reservoirs have accumulated lead through historic emissions and responsibility for remediation and abatement will need to be allocated between DRP and the Peruvian government according to existing agreements. Blood lead and environmental monitoring, education and intervention programs will need to be continued until appropriate emission reduction, remediation and abatement programs have proved successful in alleviating childhood lead poisoning.

Risk Assessment Efforts

Determining which of these measures are required, and to what degree, will entail estimating how much lead children intake from the various environmental media, how much of the lead is absorbed in body tissues, and how the primary and secondary sources affect those media. Much can be learned from how the measures taken over the past two years have affected the observed decrease in blood lead levels. These analyses are typically undertaken in risk assessment studies. Risk assessment protocols will characterize the lead content of the various media and identify and quantify the relationships between those media and the primary and secondary sources (i.e. how much lead is there in food, water, air, dust and soil and where did it come from). Route specific estimates of lead intake are then developed using assumptions regarding how much food and water children consume, how much air they breathe and how much soil and dust they ingest. Biokinetic models then estimate how much of the lead intake is absorbed by the body and manifests as measurable blood lead.

These efforts involve making several assumptions regarding the various pathways, in the smelter, in the environmental media, in the home, and in the child's body. As a result, the relative significance of the various factors can vary, depending on the database utilized and assumptions made by the assessor. It is not unusual to find major discrepancies in the initial analyses conducted by risk assessors representing different parties in these cases.

Both Activos Mineros and DRP have commissioned experts to conduct these analyses. Both consultants are using different models and it is unclear whether they will use the same database. There is the possibility of substantially different findings regarding how the reductions in observed blood lead levels were achieved (i.e. which actions resulted in the reductions and are these sustainable); and which sources are responsible for the remaining blood lead levels (i.e. pre- or post-1997 emissions). There could be controversy regarding the relative roles of active smelter and industrial complex sources and "pasivos ambientales" (legacy contaminants) that may extend to whether DRP or the Peruvian government, respectively, is responsible for additional cleanup. Opinions have already formed amongst those we interviewed and this will be one of the next chapters in La Oroya. Many children could remain at risk during the ensuing battle of the experts.

Air and Dust Lead Concentrations

Concurrent reductions, noted above in both measured air lead concentrations and limited dust lead monitoring suggest the PAMA emissions reductions efforts are having positive effects in reducing releases of lead from the smelting complex. This is likely reducing the

primary source of lead along the exposure pathways and effecting reduction in children's intake. There is suggestive evidence that exterior and interior dust concentrations have decreased. The declines due to emission reductions will likely continue to be observed, as additional PAMA improvements come on-line and community exposure medium reach equilibrium.

Transient reductions in dust lead levels are likely being accomplished through the street cleaning program. However, there has been no concerted effort to quantify this effect either in terms of dust lead concentrations or loadings, sustainability, or blood lead absorption effects.

Public Health Intervention

Emission reduction, remediation and abatement seek to remove (or isolate) lead from the children's environment, and result in minimizing or eliminating exposure. Intervention activities, conversely, seek to decrease exposure by to removing children from the leaded environment, or by modifying children's behavior and teaching families to live with that lead. The Casaracra Nursery daycare program removes children with extremely high blood lead levels (>40 ug/dl) from their home and community environment for a substantial portion of their waking hours. The program also attempts to modify both child and parental behavior through increased education regarding personal and home hygiene and nutritional counseling and dietary supplements. These efforts have effected considerable decreases in blood lead levels for these individual children. It is unclear how many of these children are included in the overall population or sentinel blood lead level summaries presented above. A significant portion of the reduction in blood lead levels noted in 2007 may be due to these children being included in the statistical presentation. It is important that the analyses of these data separate the blood lead decreases achieved through emission reductions and remediation efforts from those achieved through the daycare and heath intervention efforts.

Sulfur Oxides and Particulates

In addition to the health risks associated with lead poisoning, La Oroya also suffers significant respiratory health risks associated with sulfur oxide and particulate emissions from the smelting complex. Atmospheric concentrations of SO2 and PM10 particulates both routinely exceed health criteria in both peak and long-term averages. Peak concentrations of these pollutants generally seem to occur in the late morning, presumably during breakup and fumigation of the nocturnal inversion. In these terrain types, emissions tend to collect beneath the nocturnal inversion layer and are re-circulated , often to ground level, in the subsequent atmospheric heating that occurs with the morning sun. DRP has sought to provide some relief to these concentrations by curtailing roasting operations in anticipation of adverse inversion conditions through the Supplemental Control System.

The PAMA improvements should provide substantial relief from these contaminants. A major portion of the additional PAMA expenditures are associated with installation of

acid plants for the lead/zinc and copper circuits. This expenditure is estimated at U.S. $150M and will result in the collection and conversion of high concentration SO2 streams to a sulfuric acid product for commercial sale. Although DRP has included these costs in their pollution control expenditure estimates, there should be significant commercial advantage generated by the new copper furnace and the acid plants. According to DRP officials the sale of the acid product is not projected to amortize the plant investment, although positive cash flows were generated with the installation of some these plants in the U.S.

Sulfuric acid plants require clean inlet gases free of particulate in order to not degrade catalysts and to produce a salable product. As a result, installation and operation of acid plants remove substantial amounts of both particulate and sulfur dioxide. According to DRP, approximately 800 tons of sulfur oxides are emitted daily under the current regime. This represents about 83% of SO2 production at the complex. Currently about 17% of sulfur oxides are captured. Under the new PAMA regime, the plant will be capable of capturing 85% of SO2 emissions reducing the typical daily rate to 175 TPD. Assuming no change in stack configuration for these releases, the effect of this reduction can be estimated by a direct rollback calculation. Ambient SO2 should decrease by (1-175/800) or about 78%, if the plants are operated at all times.

According to Figure 6, annual average SO2 concentrations at the Estacion Sindicato increased from near 400 ug/m3 in 2004 to about 700 ug/m3 in 2007. This is in comparison to health standard (ECA) of 80 ug/m3. A 78% decrease in levels in a straight rollback indicates post-PAMA concentration will be considerably lower, but will continue to exceed health criteria. This reconfirms the Experts Comments review in 2006, suggesting that PAMA will improve, but not resolve, health concerns in La Oroya. Overall SO2 control exceeding 90% may be required to achieve health criteria. It should also be noted that the expected reductions will not occur unless DRP operates the acid plants continuously. There is a potential concern that the acid plants might be curtailed during economically disadvantageous periods.

Ambient Conditions during the Blacksmith Visit:

Blacksmith did receive a critique of May 2008 visit from AIDA indicating that ambient environmental concentrations of SO2 and particulates were atypically low and may have prevented the team from observing the severity of problems in La Oroya. Example data were presented and analyzed in AIDA's critique. That critique was forwarded to DRP for a response. I have reviewed the environmental data cited by both AIDA and DRP response against the Government web-site (DIGESA) for the first twenty days of May that encompassed our visit (http://www.digesa.minsa.gob.pe/php/index.php?). I was unable to confirm either AIDA's or DRP's ambient concentrations for those days and noted the following discrepancies on the days surrounding our visit (May 8-10).

For May 8, I read a higher peak SO2 concentration than both AIDA and DRP, which agree with each other. For May 9, my reading of the web-site agrees with AIDA, but is substantially lower than the DRP value. On May 10, AIDA reports no data (or near no-

detect) and DRP reports a value substantially greater than my reading of the government site. The only other apparent SO2 discrepancy was on May 18, when my reading of the web site agrees with AIDA and DRP reports a higher value. For PM10, I generally estimated values from the web-site similar to AIDA (except May 10, when AIDA was lower). DRP had higher values on four days and lower on two days.

It seems that, at least according to the values reported on the government site, that SO2 peak values were lower than average on the days we were in La Oroya. The DRP response, indicates that the Supplemental Control System was employed on those days. Presumably roasting was curtailed the preceding evening, and peak concentrations were lower during morning fumigation. The furnaces were operating, as we witnessed, and daily bullion production was normal as reported by DRP. As such the smelter was operational, but ambient concentrations were likely lower than average, and we did not experience the high SO2 ambient levels that frequently occur in late morning.

I have visited operational smelters dozens of times, both with and without the roasters and furnaces in operation, and with SO2 concentrations exceeding those reported for La Oroya in May 2008. The SO2 concentrations routinely indicated in the monitoring data are both unhealthy and unpleasant. Similarly, PM10 levels were likely lower during our visit, but the ambient monitoring record indicates that, for the majority of the time, these also exceed health criteria. I doubt that DRP specifically curtailed for our visit, and the lower ambient concentrations on those days had little impact on my assessment of the problems.

I am concerned that there are such discrepancies in the reporting of the database. As I understand the process, DRP does the monitoring, reports the results to the government, which post the data on the web-site for the public. A major problem noted throughout our visit was little or no mutual trust among the stakeholders in La Oroya and Lima. Public groups and NGOs complained they never have access to the data. Government officials and DRP report that the data are transparent and all available. CDC/ATSDR indicated these conflicts were an impediment to resolving La Oroya's problems in 2005. CDC/ATSDR recommended development of a scientifically robust program to monitor the effects of emission reductions and for all stakeholders to participate and work cooperatively in this program.

A major step in the right direction would be for the adversaries to agree on a common database. Additionally, the true indicator of how much impact the PAMA improvements produce, how serious the remaining levels of contamination are, and which sources need to addressed in the future will be determined by comprehensive analysis of the environmental and blood lead measurements. All parties need to come together and agree on which data should be collected, and the protocols for collecting and disseminating that information. Those data should then be comprehensively evaluated in a transparent manner to identify those additional measures that will be most effective in bringing about a safe environment for La Oroya's children.