



Luiz Roberto Guimarães Guilherme
Soil Chemistry & Environmental Toxicology
Soil Sciences Department



Lavras, March 16th, 2015

To the Public Authorities of Paracatu
To: Municipal Council

Ref.: Clarifications regarding the wrongful information provided by the Estado de Minas Gerais Journal and the Correio Braziliense Journal dated on the 14th of March, 2015

Dear Sirs:

As the lead coordinator of studies on arsenic bioavailability in soil and sediment collected in the gold mining area owned by Kinross in Paracatu, it was with great surprise and outrage that I have taken note of the above stated report published under the title "Alert in Paracatu", on pages 19 and 20 in the "Cities" section, of the Correio Brasiliense Journal dated on March 14th 2015 and replicated in the Estado de Minas Gerais Journal, printed on the same date.

The surprise comes from the fact that I was mentioned in the report, as stating that "results of recent studies from the University of Lavras, showed that arsenic present in the dust in Paracatu is bioavailable (i.e.: it can be absorbed by the body)". This is not true. This was not the conclusion of our study and, to date, there is no record of other studies conducted by UFLA (Federal University of Lavras), that deal with the subject matter, other than that of which I am coordinator.

The outrage stemmed from not having been contacted by those responsible for the above report, to explain its conclusions and even more so for distorting and leaking out wrongful information regarding the studies carried out by UFLA, institution of which I am Professor for the past 24 years in the Department of Chemistry Soil and Environmental Toxicology, with special focus on the issue of heavy metals in the environment. I have been working here ever since concluding my PhD studies at Michigan State University and the Institute for environmental Toxicology, in the United States in 1997.

In light of the above, and with the intent to provide clarification and reassurance to the population of the city of Paracatu regarding the true result of our studies, I found myself compelled to write this letter in the hope that you will take this message to your electorate, the people of Paracatu.

Initially, I would like to state that the information we now provide in writing, may be clarified personally during a public session at the City Council in Paracatu, on the occasion that is most appropriate for the Council and on my part.

As coordinator of the study that resulted in the publication of the article entitled "Arsenic bioaccessibility in the gold mining area: a health risk assessment for children", published in the Scientific Journal Environmental Geochemistry and Health (Volume 34, pages 457-465, 2012), written by Ono, FB; William L.R.G .; Penido, E.S .; Carvalho, G.S .; Hale, B .; Toujaguez, R .; Bundschuh, J., I have to clarify the following about the information and conclusions of this study:

1. The article in question dealt with an unprecedented assessment in Brazil in the field of gold mining, regarding the possible health risks that could arise from a hypothetical scenario of children exposure to soils and sediments of mining areas with high levels of arsenic, a trace-element (sometimes called "heavy metal") considered hazardous to health.
2. This assessment is relevant, because although there are records in Brazil in various areas with high arsenic levels in the soil, as reported in studies published by Andrade et al (2008)¹; Borba and colleagues (2000, 2003)²; Deschamps et al (2002)³ and Matschullat and colleagues (2000)⁴, none of these studies analyzed levels that simulate the fraction of the element - arsenic - that could actually be available to cause harm to human health. This fraction is called arsenic bioavailability (when evaluated in vivo tests with guinea pigs) or bioaccessible arsenic (if evaluated in vitro tests, that is, in laboratory conditions). This lack of information about possible health risk was even pointed out on page 20 of the aforementioned report, when referring to a scientific paper published in 2015, entitled "Arsenic Mobility in Sediments from the Paracatu River Basin, MG, Brazil" in the Scientific Journal "Archives of Environmental Contamination and Toxicology" (volume 68, pages 558-602, 2015), authored by Rao, PS; Costa, L. M. & Windmüller, C. C.
3. Evaluation of bioaccessible arsenic is an important tool, validated by in vivo tests (guinea pigs), to evaluate the real risks of arsenic in the soil posed to the exposed population, thus informing decisions on regulation and risk prevention.
4. The current study considered the possibility of exposure of children (the most fragile population) by involuntary ingestion of contaminated soil (due to the simple habit that children have to put their hand in the mouth), assessing the fraction of bioaccessible arsenic in soils located in the mine's area of influence operated by Kinross Brazil Mining Corporation.

¹ ANDRADE, R.P.; SANTANA-FILHO, S.; MELLO, J.W.V.; FIGUEIREDO, B.R. & DUSSIN, T.M. Arsenic mobilization from sulfidic materials from gold mines in Minas Gerais state. *Química Nova*, 31:1127-1130, 2008.

² Borba, R. P., Figueiredo, B. R., & Matschullat, J. (2003). Geochemical distribution of arsenic in waters, sediments and weathered gold mineralized rocks from iron quadrangle, Brazil. *Environmental Geology*, 44(1), 39–52.

Borba, R. P., Figueiredo, B. R., Rawlins, B., & Matschullat, J. (2000). Arsenic in water and sediment in the iron quadrangle, state of Minas Gerais, Brazil. *Revista Brasileira de Geociência*, 30(3), 558–561.

³ Deschamps, E., Ciminelli, V. S. T., Lange, F. T., Matschullat, J., Raue, B., & Schmidt, H. (2002). Soil and sediment geochemistry of the iron quadrangle, Brazil. *Journal of Soils and Sediments*, 2(4), 216–222.

⁴ Matschullat, J., Borba, R. P., Deschamps, E., Figueiredo, B. R., Gabrio, T., & Schwenk, M. (2000). Human and environmental contamination in the iron quadrangle, Brazil. *Applied Geochemistry*, 15, 181–190.

5. The results of the analysis on bioaccessible arsenic in the studied soils were used in a health risk assessment model that compares the amount of arsenic that can be absorbed by children considered to be safe, that is, below the threshold dose where toxic effects can occur.
6. The parameters used in the risk assessment are recognized as standards by international organizations, with the exception of Brazilian children body mass, which was derived from Brazil's household survey data carried out by IBGE, as described in the work of William and Marchi (2007)⁵.
7. All test and quality control procedures of the results followed international standards of analysis, with the use of certified samples and according to the strictest laboratory quality control protocols.
8. The comparison of the estimated daily intake of arsenic (through involuntary ingestion of soil and sediment from the Mine area) with that which is considered to be safe revealed that, with the exception of the sample collected from the dam tailings, the amount of arsenic hypothetically ingested represented less than 10% of that which could be considered to pose a health risk.
9. In the specific case of the sample collected from the dam tailings, although the risk assessment estimated a higher risk than acceptable, it is important to note that this material was collected from an artificial lake used for containment of waste which is permanently saturated with water, within the industrial area of the company. That is, it is an area that is inaccessible to people and does not generate dust. Even in the case of other areas where there is no evidence of health risks to children, access to children is also restricted, a fact that is well characterized on page 463 of the scientific work in question.

In addition to the explanations provided above, it is important to note that we continued to carry out bioavailability studies to try to understand why the availability of arsenic found in the soil and sediment in the mining area was low. As such we carried out sophisticated analysis with the soil and sediment, using the particle accelerator located at the National Synchrotron Light Laboratory in Campinas and at Brookhaven National Laboratory (United States). In these studies, we ensured that the low supply was related with both high stability of minerals containing arsenic (for example, in the case of arsenopyrite mentioned in the article) and the high arsenic retention capacity of new minerals that were formed when arsenopyrite underwent transformation, (i.e.: when the mined material suffered action of time - weathering). The main results of these additional studies were presented at the last world congress that deals with arsenic research⁶, held in 2014 in Argentina. A scientific paper explaining the low availability of arsenic is currently under review after been submitted for publication⁷.

⁵ Guilherme, L. R. G., & Marchi, G. (2007). Metais em fertilizantes inorgânicos: Avaliação de risco à saúde após a aplicação. São Paulo: Associação Nacional para Difusão de Adubos.

⁶ Guilherme, L.R.G.; Ono, F.B.; Cantoni, M. ; Abreu, C.A. ; Coscione, A.R. ; Tappero, R.; Sparks, D. Bioaccessibility of arsenic in a gold mine area in Brazil: why is it so low?. *Arsenic in the Environment: Understanding the Geological and Medical Interface of Arsenic*, v. 5, p. 349--353, 2014.

⁷ Ono, F.B. Ono; Tappero, R.; Sparks, D.; Guilherme, LR.G. Investigation of Arsenic Species in Tailings and Windblown Dust from a Gold Mining Area. Submetido para publicação na Revista Científica Environmental Science and Pollution Research.

The information stated above demonstrates the absence of risk to children's health derived from ingestion of soil and sediments studied in the work that we carried out with the material collected on the Kinross site.

The explanations further suggest that there is no evidence that the arsenic element, considered dangerous to human health, is likely to reach unacceptable risk levels to children's health, via the involuntary ingestion of soil, if the preventive exposure measures continue to be implemented.

Finally I would like to thank you in advance for your attention and I reinforce my availability to be present in Paracatu to provide any additional information that may be necessary about our study on arsenic bioavailability in soils and sediments from the Kinross mining area.

Sincerely,

Luiz Roberto G. Guilherme, Ph.D. Tenure Professor
Soil Chemistry and Environmental Toxicology