

# **NEW APPROACHES TO CHARACTERISING GROUNDWATER FLOW**

10<sup>th</sup> - 14<sup>th</sup> September 2001

## **FINAL PROGRAMME**

International Association of Hydrogeologists

in cooperation with

ATH Association of Tracer Hydrology

# **NEW APPROACHES TO CHARACTERISING GROUNDWATER FLOW**

10<sup>th</sup> - 14<sup>th</sup> September 2001

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## TUESDAY SEPTEMBER 11- MORNING

### INVITED SPEAKERS Session 2

Lecture room S0320: *Chairman: P. Dillon*

09.00-09.30 *P.L. Younger*: The Hydrogeology and Hydrochemistry of abandoned deep mines: Progress and pitfalls

09.30-10.00 *M. Veselic*: On the use of tracer techniques in the unsaturated zone

10.00-10.30 *H. Hötzl*: Determination of transport parameters in aquifers through tracers

10.30 *Coffee Break*

### SESSION 4 DETECTION AND SURVEY METHODS

#### SESSION 4.1

Lecture room S0314, *Chairman: T.R. Rude*

09.00-09.20 *R.I. Acworth & G.R. Dasey*: Electrical imaging of the saline intrusion pattern beneath a tidal creek in a sand aquifer

09.20-09.40 *W.G. Coldewey & P. Göbel*: Effects of stormwater infiltration on the water balance of a city

09.40-10.00 *S. Evers, S.W. Fletcher, R. Ward & R.C. Harris*: A strategy for the protection of groundwater from nitrate leaching using spatial and geostatistical analyses

10.00-10.20 *S. Grams*: Kriging hydrochemical data - problems and solutions

10.20-10.40 *Coffee Break*

10.40-11.00 *D. Hannich, H. Hötzl, G.-P. Merkle*: Application of geophysical techniques to monitor natural attenuation at contaminated sites

11.00-11.20: *A. L. Bonacin Silva & R. Hypolito*: Hydrogeochemical investigations by the use of a technical-scientific approach in the Fazenda de Itaquí drainage basin situated in the influence area of glazed ceramics industries of Santa Gertrudes, Brazil – initial results

11.20-11.40: *S. Greenhalgh, J. Zhe & B. Zhou*: A trial of cross-hole electric imaging for monitoring aquifer artificial recharge

### SESSION 3 PROTECTION OF GROUNDWATER

#### SESSION 3.2

Lecture room S1128: *Chairman: E.P. Löhnert*

09.00-09.20 *J. M. Sharp, Hansen, J. Krothe*: Effects of urbanization on the hydrogeological System: The physical effects of utility trenches

09.20-09.40 *P. Grathwohl & D. Halm*: Groundwater Risk Assessment at Contaminated Sites (GRACOS)

09.40-10.00 *K.W.F. Howard*: Polluted groundwater - deadly lessons from Walkerton, Ontario, Canada

10.00-10.20 *P.E. Ihalainen*: Hydrogeology around a small quarry in the light of ground-water protection

10.20-10.40 *Coffee Break*

10.40-11.00 *M. Karnuth, D. Schenk, T. Hofmann*: Elution of contaminants from recycled demolition waste materials

Working Group Hydrogeology and Environmental Geology (LMU, Munich)



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## **XXXI. Congress 2001 New Approaches to Characterising Groundwater Flow**

**Munich, Germany**

**10. – 14. September, 2001**

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**MANAGEMENT OF CONTAMINATED OR POTENCIALY CONTAMINATED AREAS – THE CASE OF FAZENDA DE ITAQUI DRAINAGE BASIN, SURROUNDED BY GLAZED CERAMICS INDUSTRIES IN SANTA GERTRUDES, BRAZIL (PRELIMINARY RESULTS)<sup>1</sup>**

André Luiz Bonacin Silva<sup>2</sup>, Raphael Hypolito<sup>3</sup>  
José Ferreira Assis<sup>4</sup>, Moraci Gonçalves de Oliveira<sup>4</sup>, Sergio Hornink<sup>4</sup>

The region of Santa Gertrudes, situated 180 km from the city of São Paulo, Brazil, is responsible for about 50% of Brazilian production of glazed ceramics covering (about 16 millions of m<sup>2</sup>/month). Since some decades ago, the industries of this region has produced glaze and pigment/coloring waste, which has caused environmental contamination. Although the quantity of produced waste has decreased or has been reused / recycled lately, part of this waste had been inadequately disposed on soil and lakes or ponds of Fazenda de Itaqui drainage basin, where a small stream (Fazenda de Itaqui) is surrounded by those industries.

Initial studies, examining lake water and sediments and fish samples were carried out by CETESB - Environmental Agency of state of São Paulo, during the decade of 1990, which indicated heavy metal contamination, mainly by lead.

Later, a technical-scientific detailed research project has been developed by USP - University of São Paulo since the end of 1998, including solid (soil, bottom stream and lake / pond sediments), liquid (groundwater, surface and rain water) and industrial material sampling and examination. Laboratory experiments, as well as geophysics and hydrogeological field investigations also has been carried out. The main objective of this specific research project is the evaluation of the availability and behavior of potentially toxic substances (Pb, Zn, B and others) to local environment, as result of glazed ceramics industrial waste disposal. This research will contribute to understand the consequences of the industrialization, an anthropic action, into geochemical and hydrological-hydrogeological cycles of Fazenda de Itaqui drainage basin.

It is important to see that those lakes and ponds are not natural ones, but ancient cavities opened by clay mining, used as raw material in the industries. Nowadays, some of these lakes or ponds are pay-per-fish ones, as well as there are other land uses in the area, like small farms, whose interaction with contaminated or potentially contaminated sites also can cause health problems.

All these situations and actions are included in the management of Santa Gertrudes – Cordeirópolis – Rio Claro ceramics industry region, which is a plan of contaminated or potentially contaminated area management, supported by CETESB (legal and state sphere), ceramics industries trade union of Santa Gertrudes and civil society, which also includes the participation of the universities (the scientific sphere). This interaction, involving the main social agents, is necessary to the interdisciplinary optics of the resolution of conflicting interests and environmental problems. Indeed, Fazenda de Itaqui is a sub-basin of Corumbataí drainage basin, one of the worst regions of the state of São Paulo in terms of pollution / contamination problems.

The results presented in this paper are preliminary (first phase of the management plan) and include management techniques and actions, in parallel to the environmental diagnosis and monitoring of Fazenda de Itaqui drainage basin.

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# Management of contaminated or potentially contaminated areas – the case of Fazenda de Itaqui drainage basin, surrounded by glazed ceramics industries in Santa Gertrudes, Brazil (preliminary results)

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**ABSTRACT:** The region of Santa Gertrudes, situated 180 km from the city of São Paulo, Brazil, is responsible for about 50% of Brazilian production of glazed ceramics covering (about 16 millions m<sup>2</sup>/month). Since some decades ago, the industries of this region have produced glaze and pigment/coloring wastes and part of these wastes had been inadequately disposed on soil and lakes or ponds of Fazenda de Itaqui drainage basin, causing their contamination. This work attempts to the studies that have been done by CETESB - Environmental Agency of state of São Paulo and USP - University of São Paulo. This research has contributed to understand the consequences of the industrialization into geochemical and hydrological-hydrogeological cycles of Fazenda de Itaqui drainage basin. All these situations and actions are included in the management of Santa Gertrudes – Cordeirópolis – Rio Claro ceramics industry region, which is a plan of contaminated or potentially contaminated area management, supported by CETESB (legal and state sphere), ceramics industries trade union of Santa Gertrudes and civil society, with the participation of universities (the scientific sphere). This interaction, involving the main social agents, is necessary to the interdisciplinary optics of the resolution of conflicting interests and environmental problems. The results presented in this paper are preliminary (first phase of the project) and include management techniques and actions, in parallel to the environmental diagnosis and monitoring of Fazenda de Itaqui drainage basin.

## 1 INTRODUCTION

The region of Santa Gertrudes, situated 180 km from the city of São Paulo, Brazil (Fig. 1), is responsible for about 50% of the Brazilian production of glazed ceramics covering (about 16 millions m<sup>2</sup>/month). Since some decades ago, the industries of this region have produced glaze and pigment/coloring wastes.

Lately, although the content of toxic metals (lead and others) used in industrial raw materials has decreased and quantity of produced industrial waste also has decreased or it has been reused / recycled lately, part of the wastes had been inadequately disposed on soil and lakes or ponds of Fazenda Itaqui drainage basin, causing their contamination.

## 2 INVESTIGATED AREA

Fazenda Itaqui (FI) stream is an affluent of Corumbataí river, one of the most important of Piracicaba region, state of São Paulo, Brazil. According to Barth (1987) and Salatti (1997), it is one of the

more degraded areas of the state, with water quality problems associated.

Fazenda Itaqui drainage basin has received glaze and pigment/coloring industrial effluents and sludge, which were inadequately disposed or thrown on this basin, surrounded by industries (Silva & Hypolito, in press).



Figure 1. Localization of Santa Gertrudes, state of São Paulo, Brazil.



### 3 PRELIMINARY RESULTS

Aerial photographs 1 and 2, respectively from 1995 and 1972, clearly show the landscape changes, primarily due to mining activity (clay extraction) and afterwards due to expansion of ceramics industries.

Environmental problems in Santa Gertrudes were detected after denunciations of the local population, after several episodes involving fish slaughter, anomalies in the color of streams, ponds and lakes, and pollutant puff from ceramics industries. Initial studies, examining lake water and sediments and fish samples were carried out by CETESB - Environmental Agency of state of São Paulo, during the decade of 1990, which indicated heavy metal contamination, mainly by lead.

Later, a technical-scientific detailed research project has been developed by USP - University of São Paulo since the end of 1998, including solid (soil, bottom stream and lake / pond sediments), liquid (groundwater, surface and rain water) and industrial material sampling and examination. Laboratory experiments, as well as geophysics and hydrogeological field investigations also have been carried out. The main objective of this specific research project is the evaluation of the concentration, availability and behavior of potentially toxic substances (Pb, Zn, B and others) to local environment, as result of glazed ceramics industrial waste disposal (Silva, 2000). This research has contributed to understand the consequences of the industrialization, an anthropic action, into geochemical and hydrological-hydrogeological cycles of Fazenda de Itaqui drainage basin.

Although it is very usual in São Paulo state's country side, the pragmatic solution of "mitigating" impacted areas due to mining activities, turning lakes formed by deactivated mining open pits into public leisure sites, must only be carried out after previous evaluation of local environmental conditions emphasizing the potential contamination of soil, bottom sediments, surface and groundwater.

It is important to see that those lakes and ponds are not natural ones, but ancient cavities opened by clay mining, used as raw material in the industries. Nowadays, some of these lakes or ponds are "pay-per-fish" ones, as well as there are other kinds of land use in the area, like small farms, whose interaction with contaminated or potentially contaminated sites also can cause health problems.

All these situations and actions are included in the management of Santa Gertrudes - Cordeirópolis - Rio Claro ceramics industry region, which is a plan of contaminated or potentially contaminated area management, supported by CETESB (legal and state sphere), ceramics industries trade union of Santa Gertrudes and civil society, which also includes the participation of the universities (the scientific sphere).

This interaction, involving the main social agents, is necessary to the interdisciplinary optics of the resolution of conflicting interests and environmental problems.

### 4 CONCLUSIONS AND NEXT STEPS

The results presented in this paper are preliminary (first phase of the project) and include management techniques and actions, in parallel to the environmental diagnosis and monitoring of Fazenda Itaqui drainage basin.

The first aims were the environmental diagnosis (Silva & Hypolito, in press), the beginning of dialogue among the social agents (industries, civil society, local population, university and legal/state organisms) and emergency actions: removal of industrial waste inadequately disposed in abandoned areas; control and monitoring of industrial actual waste production and destination; decrease of the content of toxic metals (Pb, Ni, Zn, Cr and others) used as raw material in glazes and pigments etc. Industries have been an important role in this part of the project.

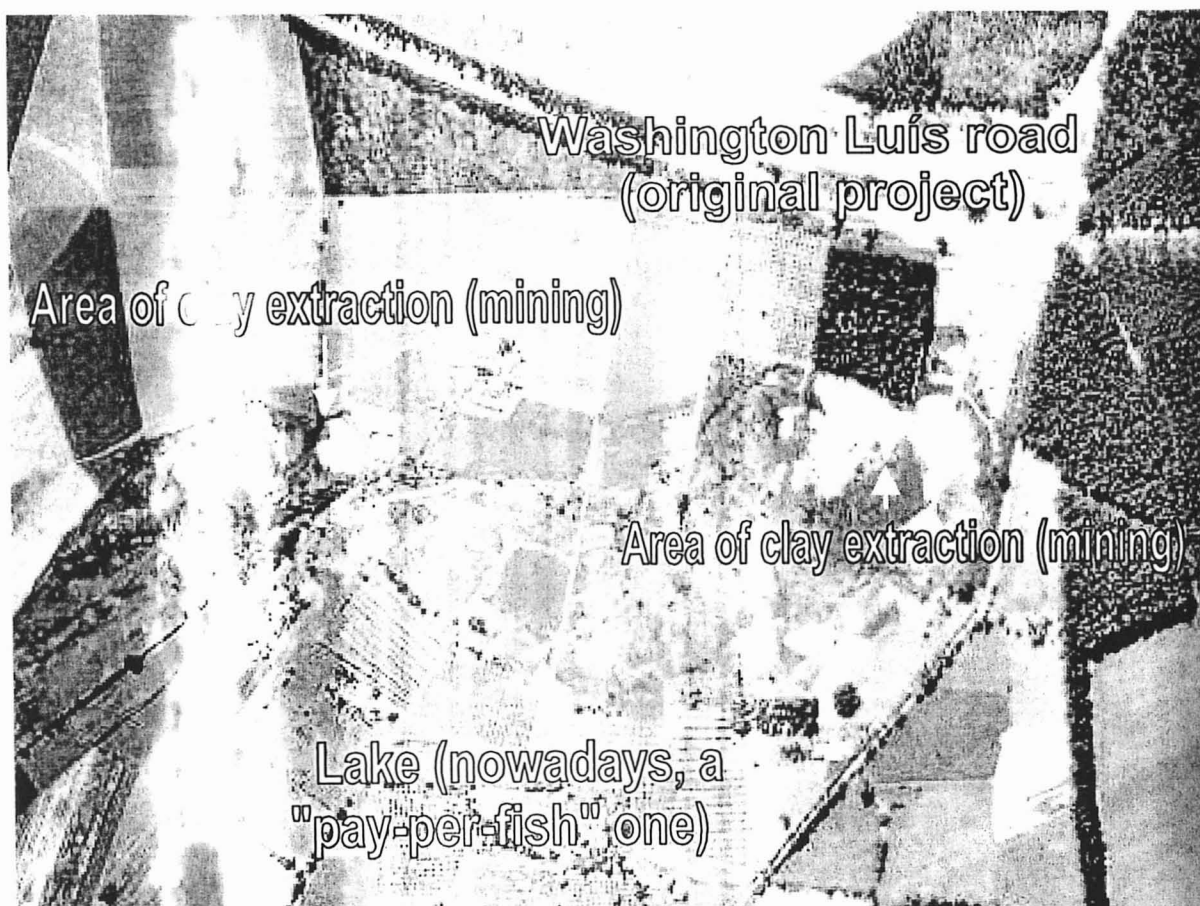
The next steps will be: environmental education; environmental monitoring in parallel to mitigative, corrective and remediation actions; detailed study of the geochemical behavior of boron in Fazenda de Itaqui drainage basin, because its high concentrations in water, soil and sediments; technological characterization and study of new uses for glazed ceramics industrial wastes; improvement of industrial processes to avoid losses.

### 5 ACKNOWLEDGEMENTS

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### REFERENCES

- Barth, F.T. & Pompeu, C.T. 1987. Foundation of water resources management. In: Models of water resources management, ABRH, p. 1-91 (in Portuguese).
- Salatti, E. 1997. Resumed environment diagnosis and water quality as part of regional integrated planning of Corumbataí river drainage basin. Dr.'s Thesis, EEESC, São Carlos, University of São Paulo (USP) (in Portuguese).
- Silva, A.L.B. & Hypolito, R. in press. Hydrogeochemistry investigations in Fazenda de Itaqui drainage basin, situated in the influence area of glazed ceramics industries of S. Gertrudes, Brazil. In: IAH Congress, Munich, 2001.
- Silva, A.L.B. 2001. Santa Gertrudes project (*Scientific report n.3, FAPESP, proc. 97/12827-2*). 1-315 (in Portuguese).



Photos 1 and 2. Aerial photographs, respectively from 1995 (1) and 1972 (2), which clearly show the landscape changes, primarily due to mining activity (clay extraction) and afterwards due to expansion of ceramics industries. Source: Base Levantamentos Aerofotogramétricos (BASE), original scale 1:25,000.