



Geological and geophysical characterization of a fractured bedrock aquifer at Jurubatuba, São Paulo, Brazil

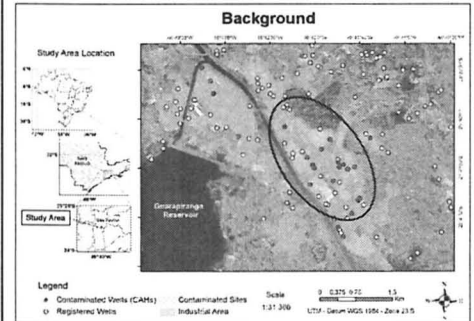
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Abstract / Introduction

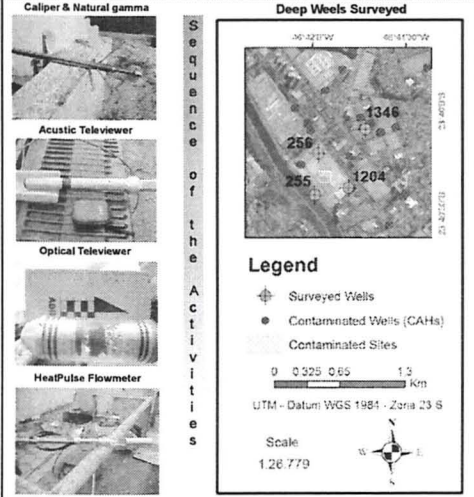
The crystalline fractured bedrock aquifer underlying the Jurubatuba industrial park area in São Paulo (Brazil) is contaminated by chlorinated solvents from multiple sources. In 2005, groundwater from eighteen deep production wells presented concentrations of chlorinated solvents above drinking water standards. Due to the regional contamination scenario, a restriction zone was established and water extraction was prohibited.

This Picture shows the study area location, the contaminated sites in beige, the deep production wells in yellow and those in red the ones that are contaminated by chlorinated solvents.



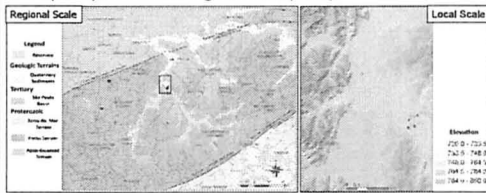
General Goal: Conduct an integrated hydrogeological assessment to better understand contaminant pathways and impacts extension survey to provided information on the structures orientation (foliation and fractures) and hydraulically active fracture zones supporting the preliminary geological conceptual model for the study area.

Methods: Geophysical Survey

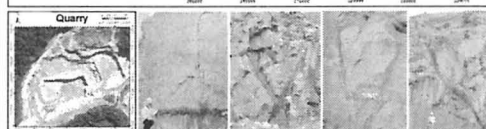
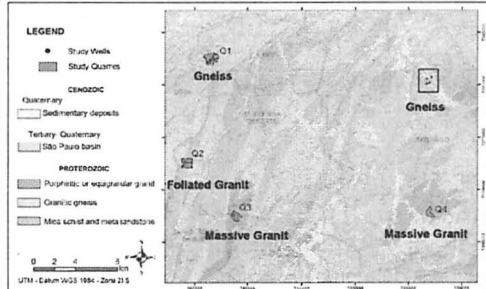


Methods: Geological Survey

Lineament Mapping: regional lineament maps from Fernandes et al. (2005); and Terrain Digital Model (TDM);

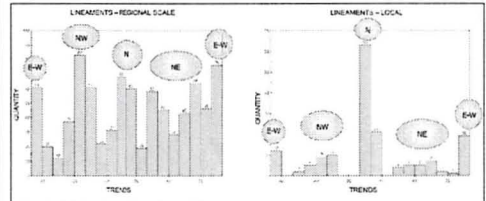


Structural Survey in Quarries Outcrops (Scanlines): 4 quarries within the same geological framework with regard to tectonic evolution.



Results from the Quarry Survey

Lineament Mapping Analysis : regionally, all directions are important. Locally, NNW and ENE directions are more significant

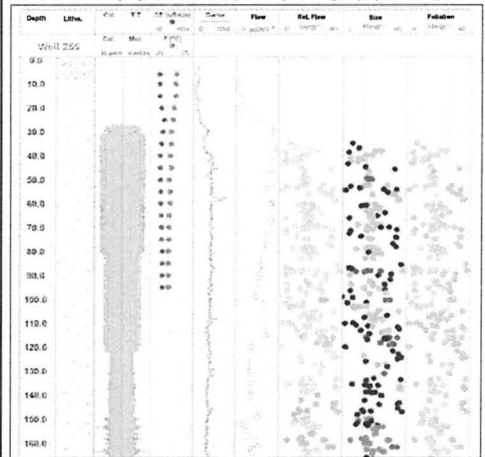


Quarry Survey: NW to NNW direction with subvertical dip seems to be the most important, followed by E-W to ENE direction with subvertical dip. NE moderate to high dip is less expressive but common in 3 quarries; and subhorizontal and N-S medium angle fractures (Q1 and Q2) are parallel to the foliation.

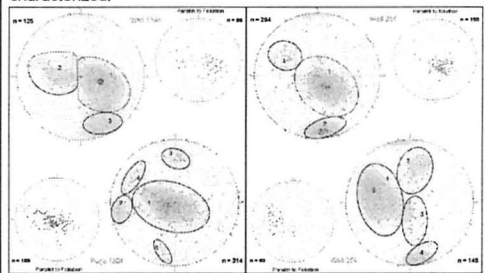


Results from the Borehole Survey

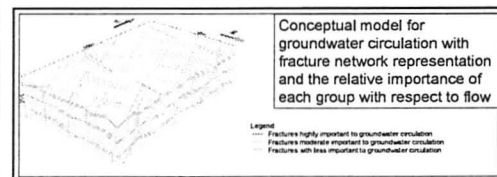
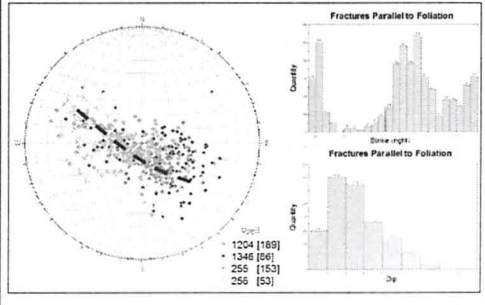
Borehole Geophysical Survey: integrated geophysical log



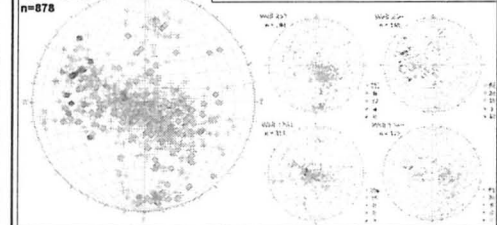
Structural Grouping due to occurrence density: Many fractures presenting low angle dip are parallel to foliation, approximately E-W and N-S high angle fracture groups were characterized.



Structural Analysis (Fractures Parallel to Foliation): the strikes are predominantly in the NE quadrant; the dip is predominantly between 10 and 40 degrees; the distribution of poles show that the foliation is folded (dashed line).



Fractures with major and high flow evidence occur mainly parallel to foliation. All Flowmeter measurements show an upward flow, indicating that the area is a discharge zone for the fractured bedrock aquifer.



Conclusions and Implications

- According to quarry survey, fractures in massive granites are mostly subvertical;
- Previous discontinuities partly control the attitude of fractures, many of these are parallel to veins and foliation, which are usually low dip angle;
- The subvertical fracture groups observed in the wells (ENE and NNW) are also important fracture groups in the quarry as well as important lineament directions;
- It was concluded that the fracture pattern is largely controlled by lithology;
- Fractures parallel to the foliation are favorable to groundwater flow;
- The groundwater flow within the wells surveyed showed an upward direction which is strong evidence that the area is a discharge zone for the fractured bedrock aquifer;
- Data integration (lineament mapping, quarry survey and well logging) greatly contributes for better characterizing the fracture network; and
- Fractures with flow evidence observed in outcrops and flowmeter data within the wells will be used to elaborate a conceptual model for the fractured aquifer in the study area.

Acknowledgements

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