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Definition of hydrogeological tectonic blocks into Guarani/Serra Geral Integrated Aquifer System using QGIS

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Abstract

The application refers to the Guarani/Serra Geral Integrated Aquifer System (SAIG/SG) in Santa Catarina State, Brazil. Based on Digital Elevation Model SRTM and derivatives, large features reflecting hydrogeological tectonic blocks[1] were defined. The interpretation of diagnostic profiles different scales result hydrogeological tectonic blocks. With hydrogeological database, calculate the hydrogeological tectonic blocks mean surface. Using QGIS Free Geographic Information System in this study was highly feasible.

Keywords

Geomorphostructures, QGIS, Terrain Profile.

1 Introduction

Serra Geral, Botucatu and Pirambóia formations constitute a major aquifer system in Southern Brazil's Paraná Sedimentary Geological Basin, the "Guarani/Serra Geral Integrated Aquifer System" (SAIG/SG). The Serra Geral Formation is a fractured volcanic reservoir that override the Guarani Aquifer System, a porous fine to middle grain sands aquifer type. Cutting both geological units, there are a lot of fractures and normal faults that connect these aquifers, allowing descendant or ascendant flow, with the exchange of different water types (Scheibe and Hirata, 2008).

The major objective of this research is the definition of the hydrogeological tectonic blocks that make up the spatial arrangement of these two aquifers, that should be exploited as a single integrated system, in southern Brazil.

The determination of these blocks is being held through QGIS and its native tools and plugins. These tools combined with a new hydrogeological database, provide support for the determination of the elevation of each tectonic block that define hydrogeological tectonic blocks, allowing to define vertical displacements and enabling to determine edge disconnections between the geologic strata layers.

To improve the technical knowledge of SAIG/SG in Santa Catarina state, this study sought support in geotechnology tools, specially the QGIS, 2.6.1 Brigthon

[1]delimited blocks from erosional features and structures, indicated by simultaneous viewing, using transparency of layers slope, hypsometry, shaded relief and drainage network, with tectonic and hydrogeological significance.

version QGIS (2015), for the definition of the hydrogeological tectonic blocks in the study area.

2 Methodology

All raster bases used in this study are derived from the digital elevation model obtained by radar interferometry by the project SRTM / NASA 2000. The spatial resolution of the images are 90 x 90 meters, originally presenting the geographic coordinate system World Geodetic System 1984 / WGS84, that was converted to plane coordinates system Mercator Universal Transverse, WGS84, zone 22 South of Equator. The following maps were drawn:

- Slope;
- Geomorphostructures at 1:1.000.000, 1:500.000 e 1:250.000 scales;
- Depth of Serra Geral and Guarani Aquifer Systems geological contact, according to well's informations, gathered in internal reports and field work.

This approach aims to define the relative movements and elevation of the hydrogeological tectonic blocks, and was complemented by the use of the plugin Terrain profile.

3 Preliminary Results

The hydrogeological tectonic blocks are interpreted on the slope map at 1:1.000.000 scale (Figure 1). The variation in slope to different areas, is a differential erosive product and suggest a relationship with hanging wall and footwall of hydrogeological tectonic blocks.

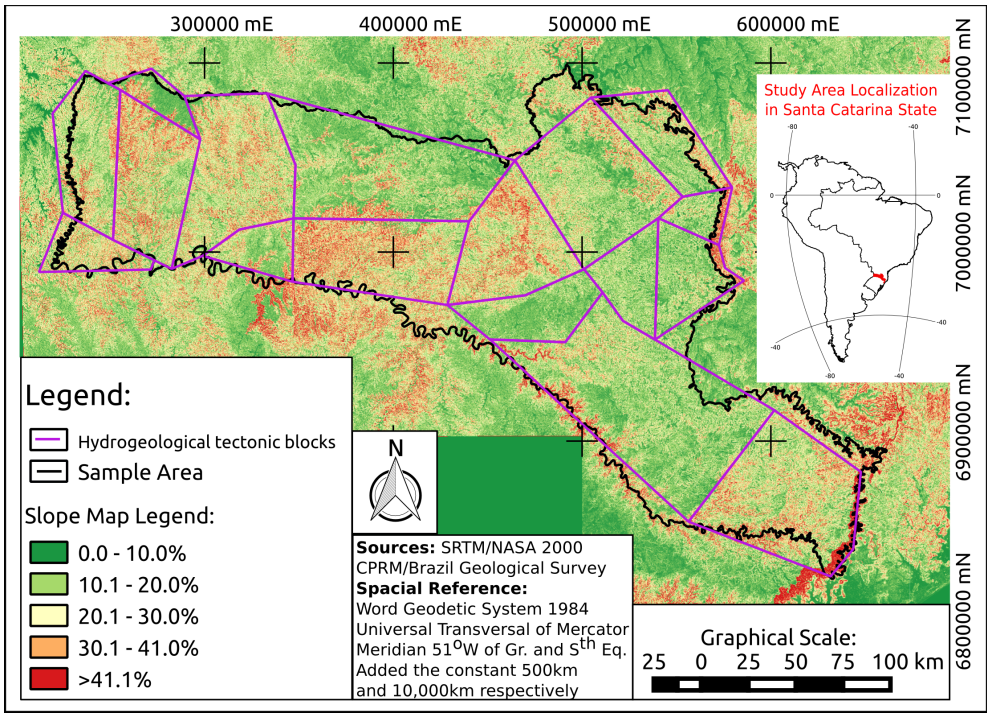

Figure 1: Hydrogeological tectonic blocks interpreted after the slope base map.

The interpretation of the hydrogeological tectonic blocks was carried out using:

- DEM: hypsometry, slope, expeditious profiles for confirmation of the blocks

(using elevation and terrain profile plugins) and;

- conference with the geological points of contact between the Botucatu and Serra Geral formations, coming from a new hydrogeological/stratigraphic database.

The analysis of geomorphological boundaries were proceeded through profiles (Figure 2) and the drainage network contributed to better definition of these limits of the blocks, through detected relief and drainage asymmetries, and indicating the likely direction movement of the blocks (hanging wall/footwall).

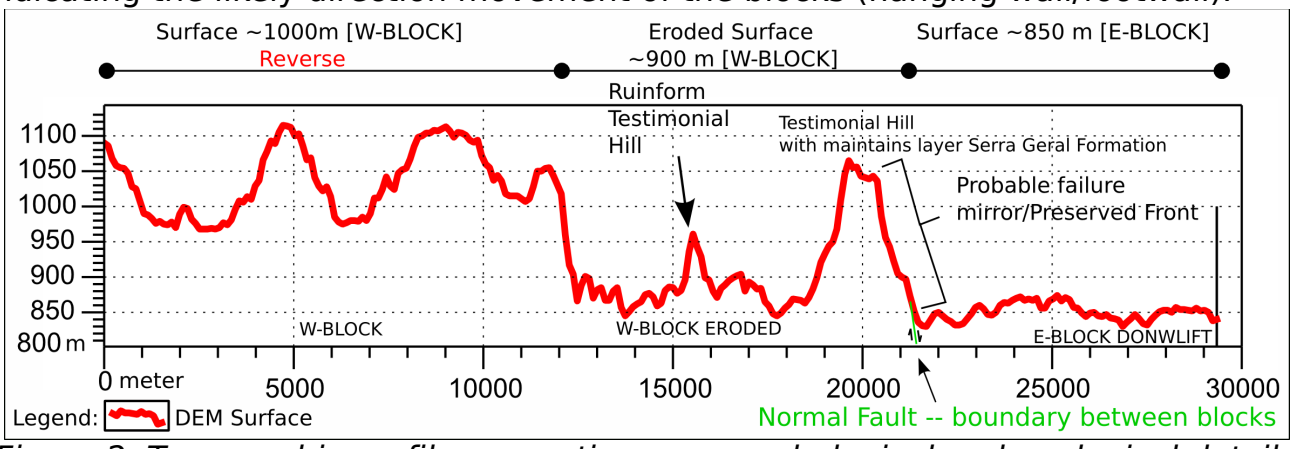

Figure 2: Topographic profile presenting geomorphological and geological details that enable the verification of the likely limits of hydrogeological tectonic blocks.

Figure 3 is the preliminary result of interpretation of the hydrogeological tectonic blocks analyzed in the 1:1,000,000, 1:500,000 and 1:250,000 scales. The numbers in the blocks represent the average altitude (related to sea level), of the contact between the base of the Serra Geral Formation and the top of Botucatu Formation (Guarani Aquifer), obtained from wells drilling data. These stratigraphic data were interpolated using the QGIS raster Interpolation tool, by the Triangular Irregular Network / TIN interpolation method. This step is important to set the hanging wall/footwall relationship of the hydrogeological tectonic blocks.

4 Preliminary Conclusions

Preliminary results corroborate and reinforce the ideas of Scheibe and Hirata (2008) and Nanni et al., (2009), which stressed the existence of discontinuities in the Guarani/Serra Geral Integrated Aquifer (SAIG/SG), eventually responsible for low productivity wells and fluoride excess in their water, and, in some cases, the formation of cells and blocks with distinct water residence time and geochemical characteristics.

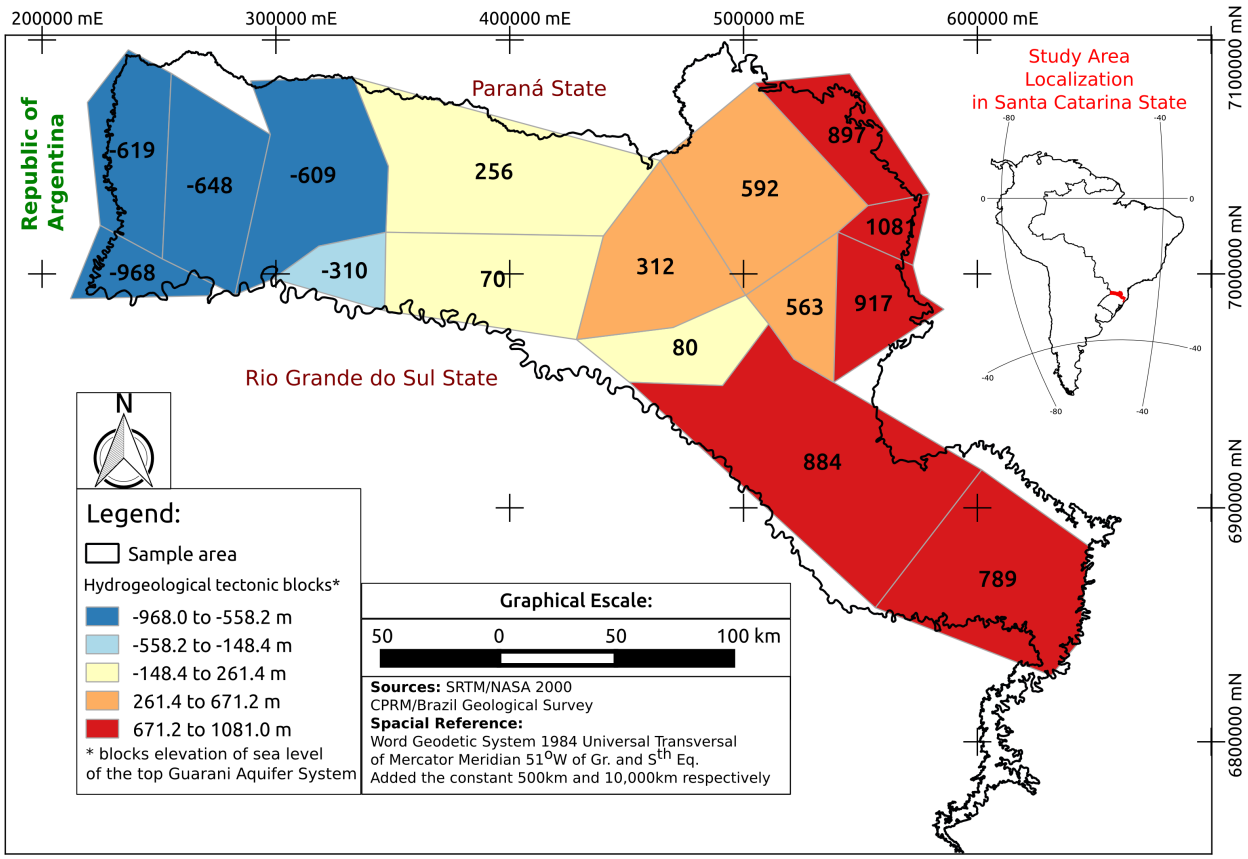

Figure 3: Hydrogeological tectonic blocks with the top altitude of the Guarani Aquifer System.

In this work, we endorse the conclusions of these authors, since significant vertical discontinuities between neighboring blocks are detected and analyzed. These suggest large lateral discontinuities in this aquifer system, which ultimately constitute an integrated system of the two major aquifers in the southeast of South America.

QGIS has been an important tool to develop this research, enabling to elaborate propositions of directions to groundwater management of Guarani/Serra Geral Integrated Aquifer System.

References

- ✓ Nanni A., Roisenberg A., Marimon M. P. and Viero A. P. (2009)"The hydrochemical facies and anomalous fluoride content in the Serra Geral aquifer system, southern Brazil: a GIS approach with tectonic and principal component analysis," Environmental Geology, 58(6), pp. 1247–1255. DOI 10.1007/s00254-008-1624-2.
- ✓ QGIS Development Team, 2015. QGIS Geographic Information System. Open Source Geospatial Foundation Project. http://qgis.osgeo.org
- ✓ Scheibe, L. F. & Hirata, R. C. A. (2008) Contexto tectônico dos Sistemas Aquíferos Guarani e Serra Geral em Santa Catarina: uma revisão. In: XV Congresso Brasileiro de Águas Subterrâneas, São Paulo: ABAS, pp. 01-14.