



HAL
open science

MRS and electrical prospection in the context of weathered peridotite rocks in the South of New Caledonia.

Jean-François Girard, Jean-Michel Baltassat, Pierre Maurizot, A. Legchenko, Benjamin François

► **To cite this version:**

Jean-François Girard, Jean-Michel Baltassat, Pierre Maurizot, A. Legchenko, Benjamin François. MRS and electrical prospection in the context of weathered peridotite rocks in the South of New Caledonia.. Magnetic Resonance in the Subsurface - 5th International Meeting on Magnetic Resonance, Sep 2012, Hannover, Germany. hal-00732912

HAL Id: hal-00732912

<https://brgm.hal.science/hal-00732912>

Submitted on 17 Sep 2013

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

MRS and electrical prospection in the context of weathered peridotite rocks in the South of New Caledonia.

Girard^{1*} J-F., J-M. Baltassat¹, A. Legchenko^{2*} A., S. Morlighem³, I. Domergue-Schmidt³, P. Maurizot⁴, J-L. Folio³ and B. François¹

¹BRGM, Orléans, France; ²IRD / LTHE, Grenoble, France; ³VALE, New Calédonia. ⁴BRGM, Nouméa, New Caledonia;
jf.girard@brgm.fr

In November 2011 and July 2012 were conducted geophysical prospections in the southern part of New Caledonia. Both electrical tomography (ERT) and Magnetic Resonance Sounding (MRS) were performed to obtain a better understanding of the water storage and circulation. The geological context is the weathering profile of peridotite rock (Maurizot and Vendé-Leclerc, 2009).

In such environment, the general distribution of geology is (from surface to depth), the iron cap, laterite (red and yellow), saprolite, fractured and then fresh bedrock. The lateritic profile is developed over a thickness ranging from 20m to 60 m.

Electrical imagery is a well-established method to detect variations in depth and laterally in this geological context (Robineau et al., 2007) and is routinely used in mining exploration and exploitation to estimate the thickness of laterite.

Hydrogeology in this environment is complex because water flows in heterogeneous media: infiltration through the iron cap, unsaturated zone, fractured bedrock. As a consequence, various regimes of hydrological responses are observed, from low permeability (laterite) to high permeable zones (fractured zone and locally "pseudo-karst" behavior).

MRS as a tool to detect directly water and provide insight of higher permeable zone sounds attractive in such a context. The sites studied are well documented thanks to pre-existing boreholes logs and hydrogeological studies.

Difficulty to perform MRS there is link to two major reasons. First, the rocks present non-negligible magnetic susceptibility. Despite surface measurement of the geomagnetic field revealed to be relatively homogeneous at the loop scale (< 100 nT variation), standard Free Induction Decay (FID) MRS measurement

appeared to be un-practicable (like observed by Roy et al., 2008). The average magnetic susceptibility is $5 \cdot 10^{-4}$ SI and it proved to be suitable to perform MRS measurement in Spin Echo (SE) mode (Roy et al, 2009, Legchenko et al., 2010, Vouillamoz et al., 2011).

The second difficulty is link with the very fine structure of laterite, where a large part of water is not detectable by MRS like bound water in clay. But the high yield zones revealed to produce a clear MRS signal in SE mode.

We present a review of the various ERT and MRS responses observed in this context.

References

- Legchenko, A., J.M. Vouillamoz, J. Roy (2010): Application of the magnetic resonance sounding method to the investigation of aquifers in the presence of magnetic materials. *Geophysics* 75: L91–L100.
- Maurizot P., Vendé-Leclerc M., 2009, Geological map of New Caledonia at 1/500 000, 1st edition, DIMENC, BRGM.
- Robineau B., Join J.L., Beauvais A., Parisot J-C., Savin C., Geoelectrical imaging of a thick regolith developed on ultramafic rocks : groundwater influence. *Australian Journal of Earth Sciences*, 54 (773-781), 2007.
- Roy, J., A. Rouleau, M. Chouteau, M. Bureau (2008): Widespread occurrence of aquifers currently undetectable with the MRS technique in the Grenville geological province, Canada: *Journal of Applied Geophysics*, 66, 82-93.
- Roy J., Legchenko A., Menier J., Chouteau M., Bureau M. and Rouleau A. 2009. MRS in spin-echo mode – 2008 tests in the Grenville. MRS2009 Workshop, Grenoble, France, Expanded Abstracts, 201–206.
- Vouillamoz J-M., A. Legchenko A., Nandagiri, Characterizing aquifers when using magnetic resonance sounding in a heterogeneous geomagnetic field, *Near Surface Geophysics*, 2011, 9, 135-144.