Deep induced polarization for geothermal and co-products exploration: improvements in the quantification of geoelectrical processes

Loris Piolat*[1], Andre Revil[2], Pierre Vaudelet[3], Yves Geraud[4], and Marc Diraison[5,6]

[1]UMR 7359 GeoRessources – Université de Lorraine, Ecole Nationale Supérieure de Géologie, Centre national de la recherche scientifique - CNRS (France) – France

[2]Université Savoie Mont-Blanc Institut des Sciences de la Terre CNRS (ISTERRE) – CNRS : UMR5275 – Campus scientifique Savoie Technolac, Bâtiment Belledonne, Bureau 252 73376 Le Bourget-du-Lac, France, France

[3]NAGA Geophysics (NG) – NAGA Geophysics – France

[4]GéoRessouces - Ecole Nationale Supérieure de Géologie (ENSG) – Université de Lorraine – Rue du Doyen Marcel Roubault 54500 Vandœuvre-lès-Nancy, France

[5]GeoRessources UMR 7359 CNRS UL – Université de Lorraine – France

[6]Ecole et Observatoire des Sciences de la Terre – Université de Strasbourg, CNRS – France

Résumé

The development of distributed acquisition systems for induced polarization geophysics enabled greater technical applicability of the methodology for deeper exploration targets. Coupled with a better understanding of electrical conductivities and polarization mechanisms, geophysicists can access petrophysical variables of great interest for geothermal and co-products exploration.
Thanks to the use of the dynamic Stern layer model, and measurements of representative fluid conductivities, geophysicists can now access several petrophysical parameters through vectorial identification of conductivity processes and application of petrophysical linear equation systems.

Porosity, clay content, and even temperature can be quantified through the use of induced polarization. More than lithological and structural identification and characterization, induced polarization methodologies can now assess alteration processes and reservoir properties, at kilometric depths of investigation.
This geophysical methodology combining large scale induced polarization equipment with petrophysical quantification of the geoelectrical signal has been applied to several geological targets, testing the widest applicability range for several industrial application (high enthalpy / low enthalpy geothermal energy, lithium exploration, hydrogen exploration, etc.). Two targets of the East African rift have been studied for different enthalpy exploration: the travertine hydrothermal chimneys of Lake Abhé and the travertine quarry of Mashyuza in Rwanda. The andesitic volcano of La Soufriere in Guadeloupe has been investigated for its high enthalpy geothermal potential. And finally, in the Grand-Est region (France), two targets have also been investigated, the granitic geothermal analogue of the Upper Rhine Graben in Sénones, and the basaltic volcano of Essey-la-côte (still in its processing stage for potential application for hydrogen exploration).

*Intervenant

Mots-Clés: Induced polarization, Geothermal exploration, Quantitative geophysics