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Hydrogeophysical survey in the regolith of a New Caledonia ultramafic massif

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In New Caledonia, understanding the hydrogeological dynamics of ultramafic massif regolith holds the key to assess management and environmental impact of nickel ore mining projects. We present a coupled analysis of Electrical Resistivity Tomography (ERT) survey and boreholes hydrogeological data from the Tiebaghi massif in the northern part of the main island.

Resistivity pseudo sections validated by numerous borehole logs contribute to defining a four-layer geoelectric model of the regolith corresponding to three main weathering horizons, wich are, from top to bottom: ferricrete with soft nodular horizon, red mottled zone and yellow fine saprolite, coarse saprolite, and the bedrock. Geological prospecting boreholes, implemented every 40m, have been equipped for groundwater monitoring. Piezometric and water conductivity maps are analysed with respect to the ERT results. ERT appears to be a useful tool to image the geometry of the regolith. Profiles reveal undulated bedrock topography, each high representing a resistive bedrock ridge and each swale corresponding to a conductive saprolite trough. When parallel pseudo sections are correlated, most ridges and troughs have a prominent NW-SE strike. However, this major structural direction does not exactly control groundwater flow pattern as defined by piezometric analysis that reveals a N50 preferential pathway. This direction matches that of normal faults developed during the last tectonic episode.

Seasonal monitoring of a selected ERT profile shows that local resistivity variations mainly occur in the mottled zone-fine saprolite layer above draining fractures. This is confirmed by hydrogeological analysis from borehole water resistivity maps.

The hydrogeophysical characterisation of the Tiebaghi massif is used to define a groundwater flow model consistent with the available geological data.