

Magnetic susceptibility and mineralogical studies of subsurface rocks from a Mexican geothermal system

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Mineralogical and geochemical studies are vital in understanding hydrothermal alteration processes within geothermal systems. These methods are expensive, require extensive sample preparation, while magnetic susceptibility (χ) method is more economical, needs no sample preparation, and is easy to analyze. The present study involves and mineral composition in drilled well rock cuttings from the Los Negritos geothermal system in Mexico. The well comprises the following litho-units: mud (0 to 543 m), basalt (543 to 1165 m), tuff (1165 to 1552 m), ignimbrite (1552 to 1795 m), breccia (1795 to 1831 m), and andesite (1831 to 2201 m). There are no significant changes in values in the top 264 m depth. A steep rise in values is observed in the mud zone at a depth of 291m (A1) and gradually decreased to 516 m (A2). The low values are expected in the mud zone as it dominantly consists of diamagnetic alteration minerals (quartz, calcite, chlorite, chalcedony, anhydrite, zeolite). The gradual changes (decrease/increase) in values within the zones of the well may not be due to lithological variations but may be assigned to the changes in hydrothermal alteration conditions. However, a steep rise in values ($4.25 \times 10^{-6} \text{ m}^3 \text{ kg}^{-1}$) at the boundary (562 m depth, A2-A3) between mud and basalt litho-units may be attributed to lithological influence. Similar variations in values are noted at the boundaries of the basalt (543 to 1165 m) and tuff litho-units (1165 to 1552 m; A8-A9 and A11 A12 in Fig. 1a), as well as within the basalt (A4-A5, A6-A7, A7-A8) and tuff (A10-A11, A11-A12) litho-units at greater depths. These observations are further evidenced by a comparable distribution pattern of hydrothermal minerals (Fig. 1b) within the lithological units and their boundaries. This study reveals the following: (i) the observed sharp changes in values (Fig. 1a) and the type of hydrothermal minerals (Fig. 1b) at the boundaries of the litho-units may be attributed to the lithological influence, and (ii) the gradual changes in values within the homogeneous litho-units may be assigned to variations in hydrothermal alteration with the well's depth.

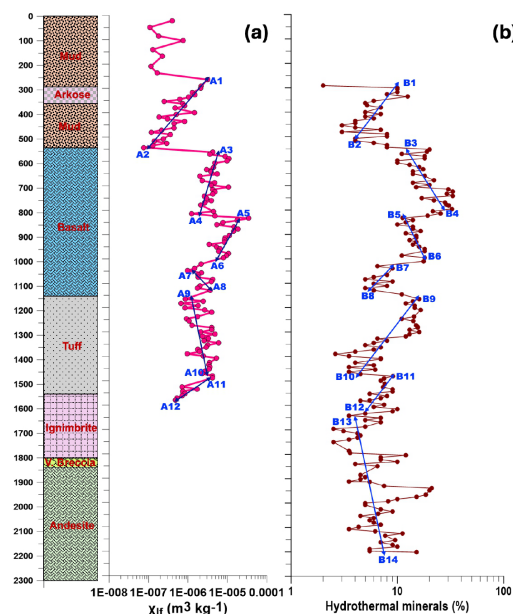


Fig. 1. Depth-wise variations of magnetic susceptibility and hydrothermal minerals in a geothermal well.