Pulsed Fast and Thermal Neutron Activation (PFTNA) calibration for Iron Ore Exploration

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Abstract

The Pulsed Fast and Thermal Neutron Activation (PFTNA) utilizes neutron interactions with matter for determining elemental grades, which is applied in iron ore exploration. Vale S.A. employed this kind of geophysical well logging in the S11D deposit to determine the elemental grades of Fe, Si, Ca, Al, Mg, C, O, and other elements. For the calibration of the PFTNA device, over three thousand chemical analyses were performed in an analytical laboratory. The predominant lithologies in the calibration process were friable hematite and jaspilite which accounted for 85% of all samples in the database provide for calibration.

Some elements such as Fe, Si, Al and P were accurately determined while others such as Cu, Mn, Ti, Mg, Ca and K did not show a strong correlation between the laboratory and those obtained from the calibrated tool. This lack of correlation can be attributed to either the quantized distribution nature these element contents or the unbalanced regarding the quantity of lithological types present in the database used for calibration.

Nonetheless, the PFTNA tool demonstrated significant potential of applicability in Vale's iron ore exploration. It swiftly determined grades of the key elements in the mineralized bodies, compared to traditional chemical methods, thus serving as a complementary methodology.