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Interpreting Neutron Absorption Macroscopic Cross-Section Measurements (Σ) in Natural Materials: the Role of Minor and Trace Elements.

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The neutron absorption macroscopic cross-section, Σ , is measured routinely by neutron porosity tools and, though rarely presented as a logging curve in its own right, is used indirectly for the estimation of (neutron) porosity. One of the reasons that this primary measurement is not often employed directly in petrophysical analysis is the difficulty of interpretation. In particular, little is known about the range of Σ values for common lithologies, or exactly what information the measurement is providing.

We can now demonstrate that excellent estimates of Σ can be calculated provided the chemistry of a sample is known in sufficient detail. When applied to a range of natural materials, it becomes apparent that the minor and trace elements present may have a profound effect on the Σ galue of a sample, and, in turn, on the interpretation of neutron porosity measurements. Using new geochemical data, Σ values are calculated for ocean floor basalts, S-type granites and serpentinised peridotites to illustrate the importance of trace and minor elements on such calculations.

Conclusions about the interpretation of $g\Sigma$ include some idea about the level of error that might be expected in neutron porosity measurements, together with some specific applications such as estimating the degree of alteration in oceanic basement or the geochemistry of acid rocks.