Redox budget: an extensive variable for quantification of redox processes

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Redox processes affect many aspects of geological systems. It is therefore useful to distinguish chemical processes that result in changes in the capacities of reservoirs to oxidise or reduce from those that do not. Two terms are proposed to make this distinction. The first is *redox decoupling*: the transport of redox-sensitive elements (e.g. H, C, S, Fe) such that reservoirs experience a change in their capacity to oxidise or reduce other material. The second is *electrochemical differentiation:* the effect of one or more redox decoupling processes that change existing gradients in redox potential.

Recognition of redox decoupling requires the use of an extensive rather than an intensive redox variable, because intensive variables do not provide information on fluxes. Redox budget, defined as the number of moles of negative charge that must be added to a sample to reach a reference state, is such a variable. Construction of redox budgets for mid-ocean ridge basalt (MORB) lavas and glasses reveals that redox decoupling occurs during crystallization at the Mid-Atlantic, Pacific and Red Sea ridges, with net oxidation of the crystallized lava.

The concepts of electrochemical differentiation, redox decoupling and redox budget may be useful for researchers studying global cycling, the formation of ore deposits, volcanism, evolution of the mantle, crust and core, redox-related environmental problems, and biotic systems.