

The renaissance of redox melting

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The concept of redox melting was introduced by Taylor [1] to designate melting caused by the increase in water activity owing to the oxidation of CH₄-rich fluids, thus explaining melting of the mantle without a change in temperature. This is thought to be especially relevant to low-degree melting where volatile components are enriched, and also to melting in the lower parts of cratonic lithosphere because of the lack of heat sources and the association with diamond, which may also result from the oxidation reaction $\text{CH}_4 + \text{O}_2 = 2\text{H}_2\text{O} + \text{C}$. A possible role for reduced fluids in the origin of kimberlites in the lower had previously been postulated by Wyllie [2], although this has not generally found favour due to the carbonate-rich nature of kimberlites.

Recent experiments at pressures relevant to the lower cratonic lithosphere have shown that small quantities of H₂O and CO₂ will cause mantle peridotite to melt at lower temperatures than with either volatile component alone, so that oxidation of C to CO₂ may provide an additional redox melting mechanism [3]. In the first "wet" redox melting mechanism, melting is caused by an increase in H₂O-activity, whereas in the second "dry" mechanism, melting results from the oxidation of C to CO₂ without a major change in H₂O activity. Both mechanisms may occur during the erosion of continental lithosphere from below in the early stages of development of continental rifts [3], and are documented in the rock types produced during development of the Labrador Sea rift [4]. Lamproites, which are typical of melting in reduced environments [5], may be produced in the early stages, whereas ultramafic lamprophyres are produced later by melting at shallower levels in more oxidizing conditions, and may result from the second redox melting mechanism. This sequence of appearance of the two mechanisms should be typical of lithosphere erosion, and the second may explain the abundance of CO₂-rich magmatism in continental rift zones.

- [1] Taylor, W.R. (1985) Ph.D. thesis, University of Tasmania.
[2] Wyllie, P.J. (1980) *J. Geophys. Res.* **85**, 6902-6910.
[3] Foley, S.F. (2008) *Nature Geosci.* **1**, 503-510. [4] Tappe, S. *et al.* (2008) *Geochim. Cosmochim. Acta* **72**, 3258-3286. [5] Foley, S.F. (1989) *Eur. J. Mineral.* **1**, 411-427.

Changes in the global phosphorus cycle during glacial terminations

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Our evaluation of phosphorus (P) dynamics in the catchment and proglacial areas of the Rhône and Oberaar glaciers (central Switzerland) shows that subglacial P weathering is mainly a physical process and detrital P represents more than 99% of the precipitation-corrected total P denudation flux (234 and 540 kg km⁻² yr⁻¹ for the Rhône and Oberaar catchments, respectively). The precipitation-corrected soluble reactive P (SRP) flux corresponds to 1.88-1.99 kg km⁻² yr⁻¹ (Rhône) and 2.12-2.44 kg km⁻² yr⁻¹ (Oberaar), respectively. Detrital P weathering rates in proglacial deposits of both catchments are calculated as 310 and 280 kg km⁻² yr⁻¹ for LIA moraines and 10 kg km⁻² yr⁻¹ for YD tills. These data strengthen the argument for substantial changes in the global dissolved P flux on glacial-interglacial timescales. A crude extrapolation from the data described here suggests that the global dissolved P flux may increase by 40-45% during the first few hundred years of a deglaciation phase.

- [1] Föllmi *et al.* *GCA*, in press.