Trace elements fractionation in Ca-rich and Ca-poor alkaline-ultrabasic series

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Two separate coexisting series, high-Ca melilite-bearing rocks and more common melilite-free alkaline-ultrabasic rocks, compose the alkaline-ultrabasic association in carbonatite massifs of Maimecha-Kotui Province, NW Siberian Platform [1]. Two analogous series are now known also in other complexes.

The trace element distributions (XRF and ICP data) in the above rocks, comparable in differential degree, from the different massifs, are clearly different. Their logarithmic relations in the sequential derivatives of the series, resulted due to fractionation according to the Rayleigh model, with different partition coefficients; then quite different rock-forming and trace element contents and their zoning patterns in coexisting minerals (EPMA data), dependent on their affiliation to the above series; as well as recent results of melt inclusion investigation in olivine of melilite-bearing rocks from the Guli and Kaiserstuhl complexes, suggest that two parent primary magmas do exist. The separate primitive magma, essentially richer in Ca, was preliminary carbonatised and enriched in Sr, REE, and Nb. Ca-poor magma can fractionate during its ascent from great depths. In turn, primary magma with higher Ca, parent for melilite-bearing rocks, fractionates only at shallower depths where CO_2 activity is lower and oxygen fugacity during crystallization of the melilite-bearing rocks is higher, as compared with conditions during differentiation of Ca-poor magma.

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Reference

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Orbital Forcing, Timescales, and the Pacing of Global Glaciations

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Not long after Hays *et al.* (1976) proved that orbital variations control climate, the technique of using orbital pacing inherent in climate proxy records to improve geologic time scales was developed. Orbital-tuning of marine or terrestrial records requires assumptions about what specific component of insolation is forcing (usually indirectly) the climate proxy, as well as the magnitude of the lag between this forcing and the climate proxy. Despite these uncertainties, the time scales developed resulted in a significant improvement over paleomagnetic time scales and even led to a reassessment of the errors inherent in radiometric dating techniques. Recently, the orbital tuning of the O_2/N_2 ratio of trapped air in Antarctic ice cores (e.g. Kawamura *et al.*, submitted) is based on a direct physical link between local summer solstice radiation and ice metamorphism; this new method may prove to be a gold standard for orbital tuning as well as make the essential point that not all orbital tuning is equally uncertain.

The extension of ice core records into the early Pleistocene, combined with O_2/N_2 time scales, should allow assessment of one of the major drawbacks of the marine $\delta^{18}O$ record; namely, that it does not speak to where, geographically, the ice volume component of climate variance originates. Since the development of the $\delta^{18}O$ proxy the general assumption has been that the ice volume signal of the last 3 Ma originated almost entirely in the Northern Hemisphere with little variance contributed by the Southern Hemisphere. By contrast, we have recently proposed (Raymo *et al.*, 2006) that from ~3 to 1 Ma a terrestrial ice margin sensitive to local summer insolation may have characterized much of the East Antarctic ice sheet. Because Earth's orbital precession is out of phase between hemispheres while obliquity is in phase, 23 kyr changes in ice volume in each hemisphere would cancel in globally integrated proxies such as ocean $\delta^{18}O$ or sea level leaving the in-phase obliquity (41-kyr) component of insolation to dominate the record. To test this idea for the origin of the *41-kyr world*, well-dated proxy records sensitive to local climate and the lateral movement of ice margins (in both the NH and SH) are needed. Would such records show precessional *and* obliquity pacing?

References

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