

Late Proterozoic alkaline magmatism in the South Brazil as an evidence of mantle heterogeneity

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Potassium-rich augite, potassic pargasite and pyrope-rich garnet were found as microinclusions in diopsides of microgranular enclaves included in a Late Proterozoic potassic syenites from the South of Brazil. Textural and chemical evidences suggest the crystallization of these minerals is related to a lamprophyric magma, which exhibits features of mingling with the host potassic syenite at mantle conditions. The presence of such mineralogy strongly indicate that mingling between these magmas, and their generation occurred at upper mantle conditions.

Isotopic composition analysis demonstrate the syenites are characterized by very low and negative initial epsilon Nd at 611 Ma (from -12.10 to -10.15), and low Sri (from 0.701 to 0.705). However two groups of samples are distinguished based on the ¹⁴⁷Sm/¹⁴⁴Nd data and whole rock geochemistry: the one with higher ratios (¹⁴⁷Sm/¹⁴⁴Nd from 0.10785 to 0.11204), lower La (around 70 ppm) higher Yb (around 2.1 ppm), lower Nd (from 10 to 30 ppm), and the other with lower ratios (¹⁴⁷Sm/¹⁴⁴Nd from 0.09361 to 0.09780), higher La (around 100 ppm) lower Yb (around 1.3 ppm) and higher Nb (from 30 to 60). Differences in some elements as Nb, and in isotopic ratio cannot be explained by simple fractional crystallization. These data strongly suggest that, although both groups are generated from the same source, the first one is more enriched in compatible elements (HREE) compared to the second one. This interpretation, together with the high pressure mineralogy, suggest the syenites are originated from a metasomatic mantle, but from different proportions of vein x peridotite-host (Foley, 1992).

References

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Origin and role of reactive halogen species in the troposphere

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It is well known that reactive halogen species (e.g. Cl, ClO, Br, BrO, and possibly I) play a decisive role in the destruction of stratospheric ozone, the mechanisms involved are largely understood. In contrast to that only during the last decade it became clear that reactive halogen species can also lead to considerable ozone loss in the troposphere. First investigations were triggered by events of total loss of ozone in the lowest ≈1000m of the polar atmosphere - the 'Tropospheric Ozone Hole'. Initially it was assumed that these tropospheric halogen events are confined to the springtime polar boundary layer (incidentally the well known Stratospheric 'Ozone Hole' also appears in polar regions in springtime). However, during the last few years significant amounts of halogen atoms and oxide radicals (ClO, BrO, IO, OIO) were detected by optical absorption spectroscopy (DOAS) and other techniques at several mid-latitude sites. Even more significantly, evidence is accumulating that BrO (at levels around 1-2 ppt) is also occurring in the free troposphere (in polar regions as well as at mid-latitudes), this could affect the tropospheric ozone budget and thus the self-cleaning capacity of the atmosphere.

In contrast to the stratosphere, where halogens are largely released from fully halogenated species (e.g. CF₂Cl₂), which are very long lived in the troposphere, likely sources of boundary layer Br and Cl are either oxidation of sea-salt halides, or degradation of short-lived organo-halogen species (e.g. CH₂BrI or CH₂I₂). Oxidation of sea salt halides appears to be a dominant Br - source at continental sites, e.g. from salt lakes (Dead Sea, Salt Lake City) and in polar regions, on the other hand there is good evidence that coastal IO and OIO originates from photolysis of organo-halogen species, likewise free tropospheric BrO appears to be supported by photochemical degradation of CH₃Br, CHBr₃, and other brominated species. This is another reason why further investigation of the global budgets of organo-halogen species should proceed at high priority.

At the levels suggested by the available measurements reactive halogen species have a profound effect on tropospheric chemistry: In the boundary layer during 'halogen events' ozone is usually completely lost within hours or days. In the free troposphere the effective O₃- losses due to halogens could be comparable to the known photochemical O₃ destruction. Further interesting consequences include the increase of OH levels and (at low NO_x) the decrease of the HO₂/OH ratio in the free troposphere.