Metasomatic perovskite

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Perovskite is one of the major minerals containing significant amount of U, Th, Sr, Hf and REE, which makes it a suitable mineral for U-Th-Pb dating and Sr-Nd-Hf isotopic analyses by TIMS and in situ techniques[1]. Generally, perovskite is occurred by magmatic crystallization in kimberlitic, kamafugitic, lamproitic, alkaline ultramafic and carbonatitic rocks[2], and rarely in carbonaceous chondrite[3]. Metasomatic perovskite, however, is rarely reported. During this study, metasomatic perovskite from numerous localities were examined for its major, trace elemental compositions, and Sr-Nd isotopic data were used to constrain its petrogenetic history.

The reported metasomatic perovskite includes those from: 1) Mantle peridotite xenolith in kimberlite, South Africa[4]; 2) Rodingite from Changawuzi in Tianshan, China; 3) Skarn formed by contact metamorphism between syenite intrusion and carbonate, Tazheran, Baikal; 4) Chlorite schist formed by dioritic intrusion into limestone in Zlatoust of Urals, Russia, and 5) Chlorite schist probably related to intrusion of the nearby syenite in San Benito of Californian, USA.

Compared with those from kimberlites and alkaline ultramafic intrusions, metasomatic perovskite is relatively stoichiometric with higher amount of Ca and Ti. In terms of trace elements, metasomatic perovskite has variable concentrations of REE, U and Th, but higher concentrations of Zr, Hf and LREE/HREE fractionation, and lower Nb, Ta and Sr.

According to our data, perovskite from Tazheran has the lowest common lead, making it a suitable standard for in situ U-Pb dating. The low Sr concentration makes it impossible to get its Sr isotopic composition using laser ablation. However, most metasomatic perovskites can be determined its Nd isotopic composition by in situ method, except those from San San Benito, which is the most stoichiometric in major elements, and has the lowest REE concentrations.

[1] Yang *et al.* (2009) *Chem. Geol.*, **264**, 24-42. [2] Chakhmouradian and Mitchell (2001) *Can. Mineral.*, **38**, 975-994. [3] Ireland *et al.* (1990) *Earth Planet. Sci. Lett.*, **101**, 379-387. [4] Dawson *et al.* (2001) *Contrib. Mineral. Petrol.*, **140**: 720-733.

Sensitivity of carbonaceous aerosol simulations to aging schemes

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Carbonaceous aerosols including organic carbon and black carbon have significant implications for both climate and air quality. In the current global climate or chemical transport models, a fixed hydrophobic-to-hydrophilic conversion lifetime for carbonaceous aerosol is generally assumed, which is usually around one day. We have implemented a new detailed aging scheme for carbonaceous aerosols in a chemical transport model (GEOS-Chem) to account for both the chemical oxidation and the physical condensation-coagulation effects, where the aging is affected by local atmospheric environment including atmospheric concentrations of water vapor, ozone, hydroxyl radical and sulfuric acid. The updated conversion lifetime exhibits large spatial and temporal variations with the global average calculated to be 4.3 days. The chemical aging effects are found to be strongest over the tropical regions driven by the low ozone concentrations and high humidity there. The conversion lifetime resulted from chemical aging generally decreases with altitude due to increases in ozone concentration and decreases in humidity. The condensation-coagulation effects are found to be most important for the high-latitude areas, in particular the polar regions, where the τ values are calculated to be up to 15 days. When both the chemical aging and condensation-coagulation effects are considered, the total atmospheric burdens and global average lifetimes of BC (OC) are calculated to increase by 52% (29%) compared to the control simulation. Model evaluation against data from multiple observation networks worldwide shows that the updated aging scheme improves model simulations of carbonaceous aerosols, especially for the remote regions. Further model sensitivity simulations focusing on the continental outflow of carbonaceous aerosols demonstrate that previous studies using the old aging scheme could have significantly underestimated the inter-continental transport of carbonaceous aerosols.

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