26th IUGG GENERAL ASSEMBLY 2015
INTERNATIONAL UNION OF GEODESY AND GEOPHYSICS
UNION GÉODÉSIQUE ET GÉOPHYSIQUE INTERNATIONALE
PRAGUE, CZECH REPUBLIC
PRAGUE CONGRESS CENTRE
JUNE 22–JULY 2, 2015
Earth and Environmental Sciences for Future Generations

Union Symposium

U5 New Discoveries in Deep Interior of the Earth and Planets

28-Jun-2015, 10:30 - 12:00

Abstract content:

East-west mantle geochemical hemispheres and its implications for a coupled supercontinent-mantle-core dynamics

In order to decode the mantle geochemical structures in both spatial and compositional domains, a total of 6854 young basalt data consisting of five isotopic ratios of Sr, Nd and Pb from almost all tectonic settings (mid-ocean ridge, ocean island, arc and continent) have been statistically analyzed. It is found that the continental basalts are heavily concentrated in the eastern hemisphere, while other basalts are distributed evenly. Independent features hidden in the data have been extracted using multivariate analysis "Independent Component Analysis". Two independent components (IC1 and IC2) explain most of the sample variance (95%), and the third minor component (IC3) accounts for 4%. Therefore, almost all young basalts covering the whole globe plot on a single compositional plane, and can be explained by only two differentiation processes (i.e., melting and aqueous fluid-rock interaction). Of the two, IC2 represents 'anciently subducted aqueous fluid component' stored for 0.3 to 0.9 Gyr in the mantle, and defines the fluid component-rich (=positive IC2) eastern hemisphere. We have also found a striking geometrical similarity between the IC2 and the inner core hemispheric structures: the eastern hemisphere shows positive IC2 in the mantle and high seismic velocities in the inner core. Combining these constraints, we propose 'top-down hemispherical dynamics': focused subduction within and around the supercontinent has created a fluid component-rich hemisphere with a lower temperature, compared to the oceanic mantle. The colder hemisphere seems to have been anchored to the asthenosphere during the continental dispersal, and may affect the temperature and growth rate of the inner core, resulting in the coupled hemispherical structures in the mantle and the core.

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Keywords:
mantle geochemistry hemispherical structure isotope fluid independent component analysis supercontinent convection

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