Evidence for ultra-depleted Pb isotopic component in the backarc Patagonian mantle wedge

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Inferences on melt and fluid migration trough the Patagonian mantle wedge are provided by the ultramafic xenoliths occurrence of Tres Lagos (TL; lat. 49.13°S, long. 71.18°W). It is placed at the eastern border of the Meseta de la Muerte backarc basaltic plateau, where a post-plateau volcanic diatreme contains mantle xenoliths in both pyroclastites and lavas. Its latitude corresponds with the Northern limit of the Austral Volcanic Arc (AVZ), which is separated from the Southern Volcanic Zone (SVZ) by a gap in the arc magmatism between 49° and 46°30′ latitude S. The selected xenoliths have been distinguished into two groups (Group 1 & 2). Group 1 consists of lherzolites and harzburgites, whereas Group 2 is constituted only by harzburgites. The Sr, Nd and Pb isotopic compositions of the Group I clinopyroxenes (Cpx) form arrays from DM to the TL basaltic lavas, according to the presence of EM1 component. Group 2 Cpx have much more radiogenic Sr and less radiogenic Nd values, approaching those of EM1 and EM2 end-members: these features are associated to very unradiogenic lead isotopic compositions ($^{206}Pb/^{204}Pb$ = 17.4-18.1; $^{207}Pb/^{204}Pb$ = 15.55-15.60; $^{208}Pb/^{204}Pb$ = 37.3-38.5). The combination of petrographic, trace element and isotopic fetures indicate that TL harzburgites are residua after melt-assisted partial melting triggered by melt/fluid migration in the hottest, and perhaps deeper, parts of the pristine DM lithosphere. The interpretation of the Pb isotope composition of Group 2 Cpx is not trivial. In analogy with the interpretation proposed for SWIR, it could unravel the occurrence of mantle sources which incorporated ancient crust and failed to homogenise with the DM mantle. Alternatively, it could be the evidence for ancient continental crust of the South America plate dragged down into the mantle by slab motion.

Black carbon as a climate agent: Least cost strategies for abatement

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Research has identified the significant radiative forcing (RF) effects of black carbon (BC) emissions. Yet controlling BC emissions is beyond the remit of the Kyoto Protocol, and instead falls under the umbrella of particulate matter (PM) control, driven largely by human health impacts. National PM legislation would offer climate effects as a co-benefit, but the question remains whether BC reduction is itself an optimal approach to climate change mitigation.

We develop cost-effective scenarios for global BC abatement in 2030. We assess the cost of abating the radiative forcing effect of BC, and the cost-effective distribution of these efforts across regions and sectors. The scenarios account for the concomitant warming effect of organic carbon (OC) reduction.

The scenarios are built upon marginal abatement cost (MAC) curves of BC abatement in each region, and the region-specific global warming potentials (GWPs) of BC and OC. The MAC curves represent the least-cost deployment schedule of BC/OC abatement technology, while the GWPs represent the climate impact of BC and OC emitted in each region relative to CO_2.

Our results suggest that the total GWP-100 (including both direct and indirect effects) of BC is highest in the Middle East, Africa, and South Asia. The annual cost of reducing global total BC RF from the 2030 baseline by 10, 20, and 30% is estimated at 2000€ 3bn, 23bn, and 97bn respectively. The industrial process and transport sectors are the largest contributors to this abatement, with China, South Asia, and Africa the dominant regions. From a global cost-saving perspective, Asia is an ideal candidate for prioritisation, owing to high baseline emissions levels and numerous low-cost abatement options – factors which outweigh its low BC GWP.

Finally, we assess the optimal level of BC abatement under alternative CO_2 permit prices. Assuming GWP-100 (direct and indirect), permit prices of €20, 40, and 60 per tCO_2 would warrant global least-cost BC reductions of 8, 10, and 12% from the baseline level.