Boron and oxygen isotopic evidence for recycling of subducted components through the Earth's mantle since 2,5 Ga

S. TURNER[1] , S. TONARINI[2], I. BINDEMAN[3], W.P. LEEMAN[4] AND B.F. SCHAEFER[5]

[1] GEMOC, Department of Earth and Planetary Sciences, Macquarie University, Sydney NSW 2109, Australia; sturner@els.mq.edu.au

[2] Instituto di Geoscienze e Georisorse, Via Moruzzi 1, 56127 Pisa, Italy; s.tonorini@igg.cnr.it

[3] Department of Geology and Geophysics, University of Wisconsin, 1215 West Dayton St., Madison, Wisconsin 53706, U.S.A.; bindeman@uoregon.edu

[4] National Science Foundation, 4201 Wilson Blvd., Arlington, VA 22230, U.S.A.; wleeman@nsf.gov

[5] School of Geosciences, Monash University, PO Box 29E, Clayton, VIC 3800, Australia; bruce.schaefer@sci.monash.edu.au

Evidence for deep recycling of surficial materials and their antiquity has long been sought to better our understanding of the role of subducting plates and plumes in mantle convection. Radiogenic isotope evidence remains equivocal because the age, extent and location of parent-daughter fractionation are not known. Conversely, whilst stable isotopes can provide irrefutable evidence for low temperature fractionation, their range in most unaltered oceanic basalts is limited and the age of any such variation is unconstrained. Here we show that $\delta^{18}O$ ratios in a number of basalts from the centre of the Azores plume drop below those of pristine upper mantle. This, combined with strongly elevated Nb/B ratios and a large range in $\delta^{11}B$ ratios (-3.3 to –7.6 *‰)*, provides unambiguous evidence for recycling of materials that had undergone fractionation near the Earth's surface. Moreover, $\delta^{11}B$ is negatively correlated with $^{187}Os/^{188}Os$ ratios that extend to subchondritic values - constraining the age of the high Nb/B, ^{10}B enriched end-member to be $\geq$ 2.5 Ga. We suggest this end-member is melt- and fluid-depleted lithospheric mantle from a subducting Archaean oceanic plate. Induced convection dragged this component down, arguably into the deep mantle, where it was stored until thermal buoyancy caused it to rise beneath the Azores islands 2.5 Gyr later.