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Mapping modern CO_2 fluxes and mantle carbon content all along the mid-ocean ridge system

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Quality criteria have been used to select $\sim$ 400 vesicularity measurements on zero-age mid-ocean ridge glasses from $\sim$ 600 data available in the literature published over the past $\sim$ 30 years. At face value, observations show that for a given depth of sampling, enriched basalts from slow spreading ridge segments are more vesicular than those from depleted and intermediate or fast spreading ridges. A shallower depth of eruption enhances these effects because lower hydrostatic pressure favours bubble expansion. In order to get an insight into these complex and intermingled processes, we used empirical and semi-quantitative approaches based on a limited number of inputs (segment depth, spreading rate and K_2O/TiO_2 ratios). Both models give equivalent results and predict vesicularities within $\pm$ 50%. From these calculations, we compute the equivalent CO_2 concentration at the depth of eruption all along the oceanic ridge system. The total calculated CO_2 fluxes are low ranging from 6.5$\pm$1.8 to 8.7$\pm$2.8 $\times 10^{11}$ mol/yr between the models and the CO_2 mantle content displays large variabilities from 66^{+27}_{-19} to 78^{+82}_{-40} ppm, with values higher near hot spots. In order to test these results, the mantle ^{3}He fluxes have been evaluated using the calculated CO_2 fluxes and a $CO_2/^3$He ratio of 2.2 $\times$ 10^9. These fluxes range from 295$\pm$82 to 395$\pm$127 mol/yr and are close to the values reported by Jean-Baptiste (1992) (267-534 mol/yr) and the most recent estimate (Bianchi et al., 2010, $\sim$527$\pm$102 mol/yr) using box-model of the three main ocean basins constrained by measurements of ^{3}He and radiocarbon data. As these independent methods give similar helium fluxes at regional and global scales, it provides strong support to a low and heterogeneous mantle carbon concentration and distribution.