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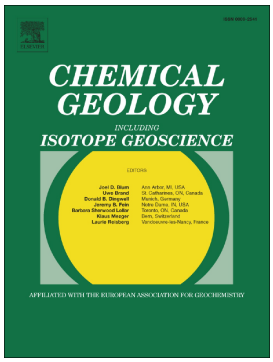


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Revision 1

# Significant contrast in the Mg-C-O isotopes of carbonate between carbonated eclogite and marble from the S.W. Tianshan UHP subduction zone: Evidence for two sources of recycled carbon

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**Abstract**

Subduction is a key process for linking the carbon cycle between the Earth's surface and interior. Carbonates in oceanic crust can be recycled into the deep mantle by plate subduction. In recent years, Mg isotopes have been successfully applied to trace the deep recycled carbonates (Li et al., 2016 and references thereafter). However, it remains unclear whether Mg isotopes can trace all recycled carbonate in the subduction zones. In this study, we petrologically and geochemically studied carbonated eclogite and marble from the S.W. Tianshan UHP metamorphic zone that was formed by the Late Palaeozoic oceanic subduction. Carbonate from carbonated eclogites predominantly consists of Fe-rich {$Fe^{\#}$ = Fe/(Fe + Mg)*100 = 19 ~ 43} dolomite with minor Fe-rich ($Fe^{\#}$ = 24 ~ 43) magnesite inclusions, whereas the carbonate from marble is major calcite and minor Fe-poor ($Fe^{\#}$ = 0 ~ 7) dolomite. The bulk Mg isotopic composition ($-0.19 \leq \delta^{26}Mg \leq 0.24‰$) of carbonated eclogite from the S. W. Tianshan is fairly higher than typical mantle-source rock (-0.25 ± 0.07‰, 2SD). Meanwhile, carbonate separated from carbonated eclogite shows mantle-like Mg ($-0.33 \leq \delta^{26}Mg \leq 0.09‰$), C ($-6.9 \leq \delta^{13}C \leq -3.3‰$), and O ($11.0 \leq \delta^{18}O \leq 12.3‰$) isotopic characteristics, indicating most or at least part of their carbon stems from Earth's mantle. Although recycling of the carbonated eclogite in the subduction zone could partly affect mantle carbon budgets, it should have no relationship with the low $\delta^{26}Mg$ signature of the mantle. In contrast, bulk marble shows sedimentary carbonate-like Mg ($-2.72 \leq \delta^{26}Mg \leq -2.15‰$), C ($0.1 \leq \delta^{13}C \leq 1.9‰$), and O ($16.7 \leq \delta^{18}O \leq 22.1‰$) isotopic characteristics, indicating all of the carbon in marble precipitated from seawater. Recycling of