CONSTRAINTS ON THE MECHANISM AND TIMING OF SEDIMENT RECYCLING BENEATH THE TONGA-KERMADEC ARC FROM Be ISOTOPES

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The fate of sediment subducted beneath island arcs and where and how portions of this becomes returned to the surface in arc lavas has profound implications for the thermo-mechanical nature of the mantle wedge and crustal evolution. Here we compare the $^{10}Be/^{9}Be$ isotope ratios in Tonga-Kermadec arc lavas with a $^{10}Be/^{9}Be$ profile from the subducting sediments which support previous geometric evidence that the sediment component takes several million years longer than the subducting plate to reach the magma source region beneath Tonga. Importantly, we also show that these arc lavas trend towards Th/Be and Li/Be ratios which are much lower than either the bulk sediment or the mantle wedge. This cannot be explained by bulk sediment addition and so requires addition of a sediment partial melt. Experimental data on these sediments constrain this to occur at approximately 775¡C between 0.5 and 2 GPa. Thus, the data require a hotter thermal structure and a more complex pattern of convection in the mantle wedge than has previously been inferred in models assuming a simple mechanical coupling between the wedge and the subducting plate. This may be linked to evidence for southward flow of the mantle parallel to the trench axis.