**Mass Balances of Subduction**
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A first order estimate of the global flux of sediment and altered ocean crust into and out of the mantle via subduction zones is essential to understanding large scale Earth processes. Constraining this flux of material requires reliable input (both sediments and altered oceanic crust) and output (fluid, volcanic front and back-arc) data (compositions and volumes). The Mariana arc is a well-studied arc system for which a comprehensive data set is available and thus has been the target for such calculations.

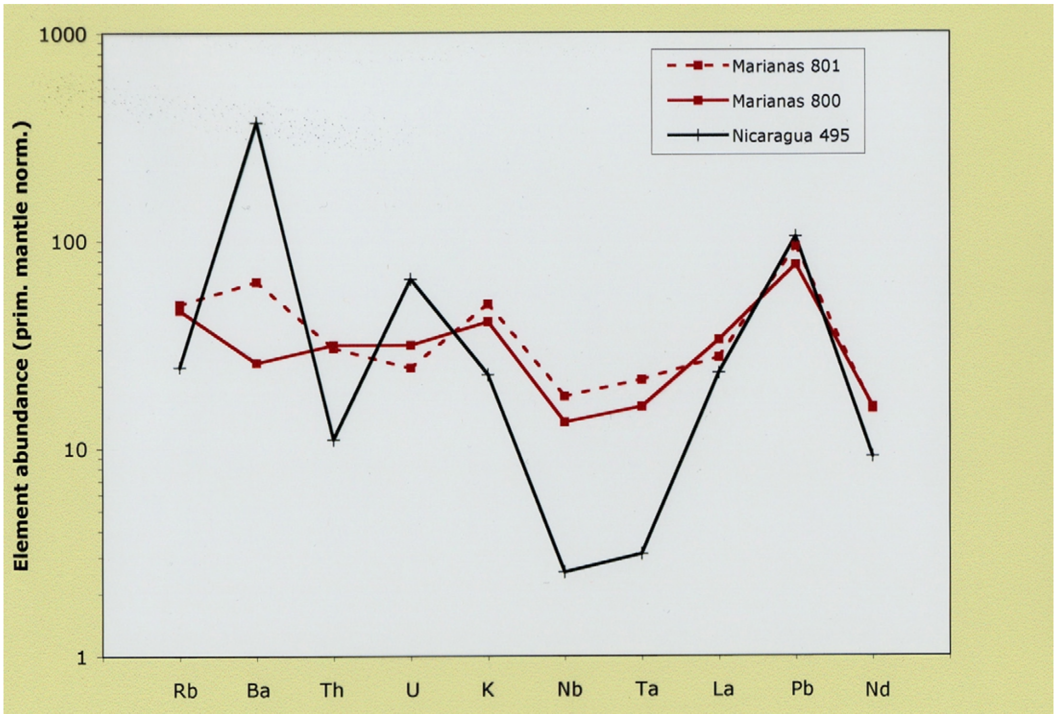


Figure 1

The sedimentary input based on ODP drill sites (800 and 801) shows that in terms of incompatible elements, the sedimentary input is fairly homogeneous (Fig. 1) across the arc, but is different to the input of other arc systems (eg. Nicaragua).

Despite a seemingly homogeneous input, significant variability can be seen when comparing data from different islands (Fig. 2). By plotting Ba/Th versus La/Sm a distinction can be made between fluid derived from altered oceanic crust (high Ba/Th) and additions from sediment input (high La/Sm). Figure 2 shows that there is a large

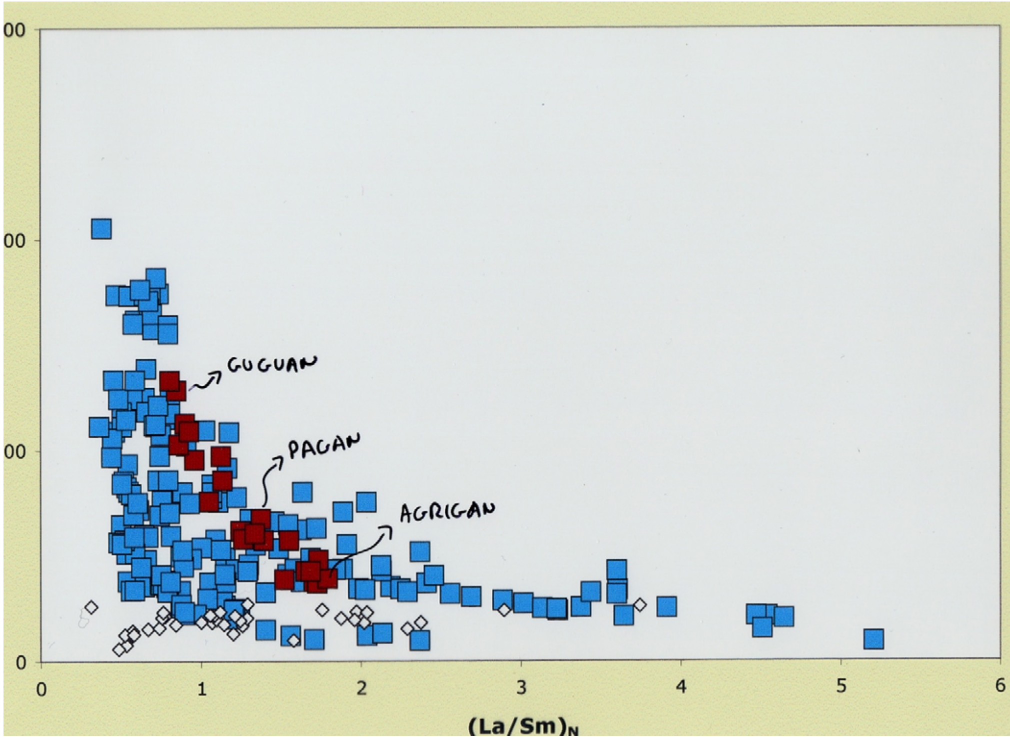


Figure 2

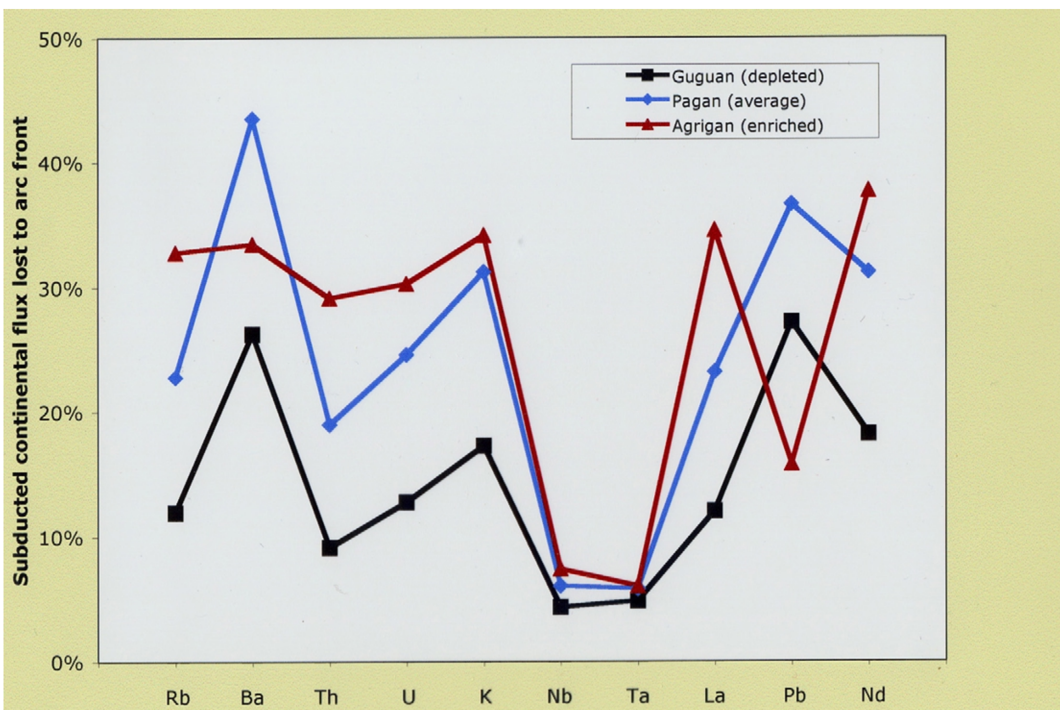


Figure 3

sedimentary input in Agrigan as opposed to Gugan, whereas Pagan falls somewhere in the middle.

For each of the studied islands a mass balance calculation has been made using the following equations for different elements of interest (X):

$$INPUT = \upsilon_{convergence}([X]_{sed}*H_{sed}*\rho_{sed} + ([X]_{AM}-[X]_{MORB}*H_{AM}*\rho_{AM})$$

$$OUTPUT = \upsilon_{arc}*\rho_{arc}(([X]_{lava}/F_{xal}) - ([X]_{wedge}/F_{melt)}) + \upsilon_{BA}*H_{BA}*\rho_{BA}*[X]_{fluid}$$

Where $\upsilon$ = velocity
H = thickness
$\rho$ =density
F = fraction of either fractional crystallization (xal) or of melt
AM = altered MORB
BA = back-arc

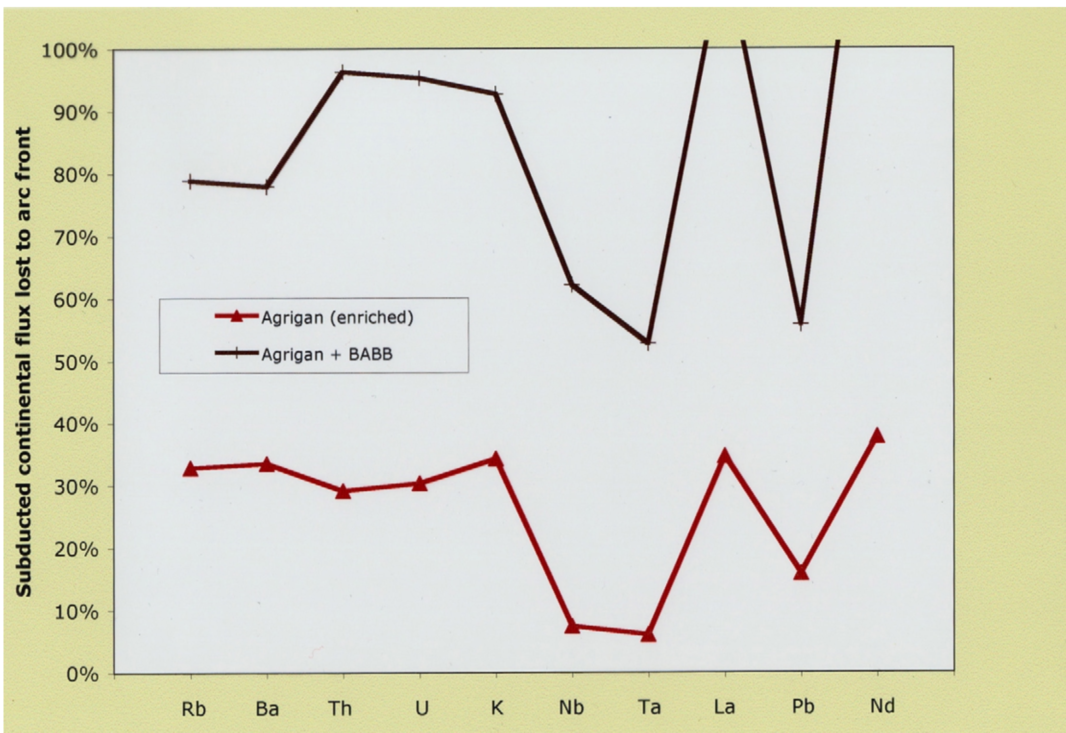


Figure 4

The results show that for the islands studied, the subducted continental input flux lost to the arc front varies from 10 to 40% for the various incompatible elements (Fig. 3). Furthermore if the back-arc basin volcanics are included in the mass balance, between 80 and 90% of the highly incompatible elements are returned to the crust through the arc and back-arc related volcanism (Fig. 4). This seems to suggest that very little of the highly incompatible elements actually make it down into the deep mantle and cannot account for the recycled component in OIBs.