U-series disequilibria in SW Pacific island arcs

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A review of the island arc literature from the past two decades highlights the profound impact U-series disequilibria measurements have had upon our understaning of magmatic rates and processes. The observations are most extreme in the depleted lavas from the southwest Pacific arcs (Tonga, Marianas and eastern Sunda). A number of geochemical lines of reasoning suggest that sediment (melt) and fluid contributions are added separately from the subducting plate. U-series and Be isotopes can be used to infer that the sediment component is added ~ 350 kyr to a few Myr ago, possibly via alternating amphibole formation and breakdown reactions migrating into the mantle wedge. Formation of a sediment melt is permissable in thermal models that assume a temperature dependent viscocity.

In contrast, estimates for the timing of fluid addition are decreasing with the most recent U-Th-Ra data suggesting this probably occurs within millenia of eruption rather than 10's kyr. Such a short time scale requires a rapid physical mechanism such as hydrofracturing. The corolory is that melt ascent occurs via chanelled, as opposed to percolative, flow through the mantle wedge liming the amount of melt – wall-rock reaction that can take place. The observation of apparently fluid-related disequilibria 100's km from the trench in lavas from the back-arc spreading centres of both the Lau and Manus basins remains an outstanding issue.

Near ubiquitous Pa exceses require in-growth in a dynamic melting process whereby the mantle wedge flows through the melting region. A road correlation between average Pa excess and local subduction rates suggests this reflects the induced convection within the mantle wedge.

$^{21\circ}$Pb disequilibria exhibit both deficits and excesses indicating both gas loss and accumulation within individual arc volcanoes. In more silicic magmas this may require gas transfer via gas-laden packets, pipes or fractures. The deficits indicate degassing over a few decades prior to eruption whereas the excesses require gas flux from volumes of magma which are 2-10 times those of the erupted volumes suggesting the presence of significant magma volumes at depth.

Limits and possibilities for subsistence and climate reconstruction based on organic and inorganic oxygen isotopes in vertebrate calcified tissues

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We report on the oxygen isotopic composition in three different populations: 1) experimental rodent cohorts that vary in their location of birth, domicile and in the isotopic composition of their drinking water, 2) late Pleistocene mammoths recovered from known latitudes and 3) several archaeological human populations from known locations and with variation in their diets.

The ability to assess differences in the local hydrology and drinking water $\delta^{18}O$ is limited by at least two factors: the compression of the meteoric water oxygen isotopic values in both inorganic and organic animal tissues and the influence of food $\delta^{18}O$ values in consumer tissues. In spite of these limitations there is a robust relationship in the mammoth population between the organic oxygen values in collagen and the latitude of origin. In contrast, human $\delta^{18}O$ values from both apatite and collagen can be impacted by complex dietary inputs in ways that obscure drinking water oxygen isotopic values.