Subduction-related magmatism along the southeast margin of the North Fiji backarc basin

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The North Fiji backarc basin (NFB) began opening ~12 Ma in response to subduction reversal along the Vanuatu section of the Proto-Vitiaz arc. The triangular shape of the basin reflects ongoing (since ~5 Ma) southward propagation of the backarc spreading centre in response to westward roll-back of the Vanuatu trench and eastward roll-back of the Tonga trench. The resultant extensional tectonic regime in the area between these trenches has caused rapid anti-clockwise rotation of the Fiji platform between ~5-3 Ma. This rotation was associated with extensive shoshonitic magmatism which has progressively migrated southwards across the platform, culminating at ~4 Ma. The most primitive shoshonites are olivine-clinopyroxene-phyric basalts (MgO to 13 wt%) with phenocryst Mg# to 92.5. The shoshonitic magmas have probably formed via melting of the metasomatised subarc mantle caused by influx of hot asthenosphere in response to the detachment of the Proto-Vitiaz slab. During this time (5-3 Ma), a short-lived intraoceanic arc, the Hunter Ridge, formed along the southeast margin of the NFB. This arc magmatism occurred in response to a short period of NNW-directed subduction of the South Fiji basin crust under the NFB. At the northern end of the Hunter Ridge (Kadavu Is.), magmatism persisted until ~ 0.5 Ma. Kadavu is composed of adakites which first erupted at ~ 3 Ma. The most primitive adakites on the island are olivine-clinopyroxene-phyric high-magnesian andesites (MgO ~8 wt%; SiO_2 ~55 wt%) with ~1500 ppm of Sr, Sr/Y of ~130, and La/Yb of ~35. Phenocrysts are highly magnesian (to Mg# of 92). These are the most primitive adakites known worldwide. Isotopically, Kadavu adakites correspond to the ragiogenic end of the Pacific MORB field in Sr-Nd-Pb space ($^{87/86}$Sr ~0.70315; $^{143/144}$Nd ~0.513038; $^{206/204}$Pb ~18.87). The southern end of the Hunter Ridge is presently volcanically active in response to southward propagation of the NFB backarc spreading centre. This area has been mapped and sampled during the SS10/2004 cruise of R/V "Southern Surveyor". Arc rocks in the area are dominated by olivine-clinopyroxene-phyric basalts with phenocrysts Mg# to 94. We will present detailed geology, geochemistry and mineralogy (including melt inclusion compositions) of all volcanic rock from this region and discuss their origin.

Magmatic evolution in the Lau-Tonga arc-backarc basin system

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It has been a widely held view that the compositions of arc lavas preserve features of two chemically distinct components derived from the subducting slab. The first is sediment which carries a range of incompatible elements into the mantle wedge and is responsible for observed enrichments in, for example, the light rare-earth elements. The second slab-derived flux is an aqueous fluid, which selectively transports only the highly fluid-soluble elements (e.g., Rb, Ba, Pb). The paradigm is that, in cases of sediment involvement, the budget of almost all incompatible elements will effectively be dominated by this component and the fluid flux will have little impact. In contrast, for those arcs in which sediment subduction is minor or effectively absent, the fluid has the greatest influence on modifying the mantle wedge.

More recently, some authors have further linked the compositions and physical properties of the two components with their source within the slab such that the sediment contribution is delivered in the form of a partial melt, physically (and temporally) separate from any fluid flux, the latter being derived from altered basaltic oceanic crust. In contrast, others have argued that slab-derived fluids will scavenge elements from all available components.

We present new trace element, Sr-, Nd-, Pb- and Hf-isotope data for Lau Island and Lau Basin magmas in order to provide insights into the evolution of the Tonga-Lau subduction system. Clear evidence for a sedimentary component in the Lau Island magmas is provided. Our results also suggest however, that the small but important contributions made by the mantle wedge itself to the incompatible trace element inventory of arc magmas should not be overlooked when framing petrogenetic models.