# Source depletion versus extent of melting in the Tongan Sub-arc mantle

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The currently active Tonga arc produces some of the most depleted compositions found in oceanic arcs. This signature is observed most strongly in their depletion in High Field Strength Elements (HFSE) relative to Depleted MORB Mantle (DMM) and Light Rare Earth Elements (LREE) compared to MORB and OIB. Previous work on low HFSE concentrations in the sub-arc mantle has produced two fundamentally different models; (i) prior melt extraction in the back-arc that depletes the source of arc magmas in the most incompatible elements [1]; or (ii) higher degrees of partial melting during arc magma production [2]. Here we present new Nb-Ta data for Tongan volcanics in order to try to differentiate between these models by developing a model for melt generation in the mantle underlying the Tonga arc/Lau Basin back-arc system.

Nb/Ta ranges from 18-3.5, with Nb between 0.2-0.4ppm. Data were acquired by LA-ICPMS of non-fluxed sample glasses produced using a molybdenum strip fusion technique. Significantly, the lowest Nb/Ta values are found in the north of the arc where both subduction and attendant back-arc spreading rates are greatest. These findings are in agreement with a model whereby greater degrees of mantle melt extraction in the back-arc produces more depleted source compositions beneath the arc [3].

Large degree batch melts (up to 35%) of DMM fail to reproduce the sub-chondritic Nb/Ta values (<17) of the arc. Alternatively, melting of source compositions having undergone 0.1-7% prior melt extraction produce melting curves that bracket the dominant arc trend.

Nb normalised plots of fluid immobile elements (e.g. Yb vs. Sm) produce a linear array that plot parallel to mixing lines for 20-35% remelting of 0.1 and 7% depleted DMM sources. Simple calculations show that the average sub-arc Tongan source melts at between 1-1.25% depletion. In the case of the Lau Basin spreading centre, this corresponds to the incorporation of the lower 4-5km of the melt column in to the sub-arc melting regime. This is in excellent agreement with current models for melting regimes at active spreading centres whereby only the lower most portion of the melting column has flow paths within the convecting asthenospheric mantle [4].

## References

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# *In situ* determination of arsenic speciation in natural fluid inclusion from Au-rich quartz veins

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Elemental speciation (i.e., oxidation state, nature of aqueous complex) in hydrothermal fluids is crucial for modelling fluid-fluid and fluid-rock interactions. Elemental speciation in hydrothermal fluids preserved as fluid inclusions can be studied by heating the host mineral while performing X-ray absorption spectroscopy. This technique was applied to fluid inclusions from gold mineralisations at the arsenic K-edge. As and Au are closely associated in many Au deposits, but the cause of this association remains controversial. We aim to better understand As transport in Au-bearing fluids by comparing speciation in natural fluids with recent experimental results on synthetic systems.

XRF mapping of single fluid inclusions showed heterogeneous elemental distributions at room temperature (Fig. 1), thus stressing the need of performing spectroscopic analyses at homogenisation temperature.

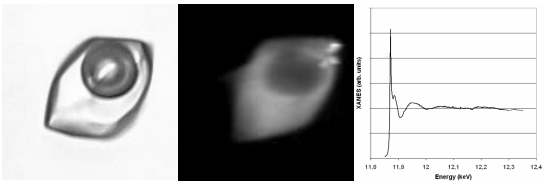

**Figure 1:** left: optical view of a $CO_2$ rich fluid inclusion. Middle: As distribution in the same inclusion. Right: XANES spectrum at the As-K edge at room temperature in an inclusion of the same generation.

XANES experiments were performed using a Linkam THMSG-600 heating-stage on the new microfocus end-station installed on the ESRF FAME beamline. XANES spectra (Fig. 1) were measured from 25 to 350°C to record evolution in arsenic speciation in those fluid inclusions.

This work details arsenic speciation changes upon heating and stresses the high interest of fluid inclusion studies based on experiments performed *in situ*.