The subduction zone signal in continental basalts

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Subduction of oceanic and continental lithosphere is the most fundamental mechanism to achieve downward material flow within the upper parts of the Earth. Devolatilisation of downgoing slabs, predominantly the release of water-dominated salinar fluids from subducting oceanic lithosphere fluxes the overlying mantle wedge and causes partial melting that feeds island- and continental arc magmatism. These fluid-triggered melting processes occur within short time-spans, i.e. in direct response to slab devolatilisation as is evident from studies of cosmogenic ^{10}Be or U-Th disequilibrium in arc magmas.

We suggest that beside such comparatively shallow devolatilisation processes, deeply subducted crust causes additional metasomatism of lower parts of the lithospheric mantle without causing surface magmatic avtivity. Melting of such subduction modified deep lithospheric mantle, however, can occur tens to hundreds of million years later in response to continental extension and local lithospheric decompression. Evidence for this comes from trace-element and isotope data of low-degree alkaline mafic to ultramafic intraplate basalts (basanites and nephelinites to melilitites), which bear distinct features that suggest an origin within the lowermost part of the lithospheric mantle, along with limited amounts of crustal assimilation. A detailed investigation of HFSE and other trace-element and Pb-isotope systematics, however, enables an alternative genetic model, in which the geochemical signatures are best explained by assuming remelting of a lithospheric mantle source that was metasomatised by supercritical liquids released from fast subducting continental crust at moderate temperatures (<900°C) but high pressures >4 GPa (>~130 km).