Melting of subducted felsic crust

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There are two main types of melting of deeply subducted felsic crust. Sediment melting in oceanic subduction zones is triggered by the influx of aqueous fluids at temperatures of 750-900°C. In subducted continental crust, melting is related to the breakdown of the hydrous phase phengite typically at temperatures of ~1000°C, 4.5 GPa. In this contribution, we compare results from high pressure experiments and geochemistry of ultrahigh-pressure rocks to evaluate the chemical signature and fate of crustal melts produced at 100-150 km depth.

Experiments on partial melting of felsic crust at subarc depth show a systematic change of melt compositions. With increasing temperature, the K_2O content of melts increases moderately, the LREE contents increase dramatically, whereas the water content decreases. Melts produced at 750-900°C have trace element patterns similar to arc lavas.

Partial melting of metasediments in subducted continental crust at diamond facies metamorphic conditions is documented in the Kokchetav massif (Kazakhstan). In rare cases, melt inclusions are trapped in peak metamorphic garnet. Experimental homogenisation of the inclusions allowed major and trace element analysis of these melts. The melts are granitic and are characterised by extreme enrichments in LREE, Th and U but only moderate enrichment in LILE and no depletion in Nb. Restitic garnet-bearing gneisses have complementary depletion patterns. The melt compositons are remarkably different from the trace element signature found in arc basalts, arguing against involvement of this type of melting in the generation of arc crust.

The interaction of felsic melts with mantle wedge peridotites can lead to a variety of modified melt compositions, as well as to a large range of metasomatic rocks. The K_2O, LREE and H_2O systematics of arc lavas are best explained by minimal interaction of sediment melts with peridotites indicating that melt transport in channels is likely above subducted oceanic crust. Element recycling is more complex in continental subduction zones. A large variety of magmas ranging from felsic, intermediate to mafic compositions can be generated from melting of the crust and variably metasomatised mantle.