The influence of minor elements on melting of eclogite in the mantle

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An important role for recycled mafic crust in upper mantle magma-genesis is frequently postulated. Models vary between those in which siliceous to basaltic melts from minor mafic heterogeneities in peridotitic upper mantle are extracted directly from their upper mantle source regions without significant interaction with peridotite wall-rock before eruption, to those which postulate reaction and resorption into enclosing peridotite of siliceous partial melts from eclogite or pyroxenite, resulting in refertilisation of the peridotite and formation of new, opx-enriched lithologies. Melting of these refertilised peridotites provides the erupted magmas.

Critical to testing these opposing models is detailed knowledge of the partial melt products of mafic lithologies at high pressure. We report experimental investigations of high pressure melting of volatile-free eclogite and carbonate-bearing eclogite, focussing on the importance of some minor elements in controlling subsolidus mineralogy, low degree melting relations and partial melt compositions.

We determined the phase relations and partial melt compositions of a nominally anhydrous altered MORB composition (GA2) with 49.7 wt% SiO_2, 0.37 wt% K_2O, 3.34 wt% Na_2O, 0.23 wt% P_2O_5 and 1.82 wt% TiO_2, from 3-5 GPa and 1200-1600°C. We identify two distinctive melting regimes. Low degree melting (≤20%) is eutectic-like and is dominated by contributions from accessory phases (K-feldspar, rutile, quartz/coesite and possibly apatite), with additional components from garnet and clinopyroxene. At 3 GPa K-fd, rt and qz are residual phases up to about 40°C above the solidus, but at higher pressures K-fd and rt melt out close to the solidus. At higher degrees of melting, once accessory phases are melted out, melt compositions are controlled by melting along ga-cpx cotectics. Low degree melts are dacitic and trend towards andesitic and basaltic andesitic with increasing temperature. At 3 GPa Na, Ti and K are incompatible, but at 4 and 5 GPa Na becomes compatible, yielding increasingly fractionated Na/Ti and Na/K in melts.

Similar dual melting behaviour is observed in partial melting of Ca-Mg-carbonate-bearing eclogite, where low degree partial melts are sodic calcio-dolomitic to dolomitic and are controlled by eutectic melting relations on the calcite-magnesite join, with minor contributions from ga + cpx. Increasing degrees of melting, or melting of residues after carbonate melt extraction, result in progressively more siliceous partial melt compositions. Interactions between these carbonated melts and peridotitic wall rock could generate a spectrum of enriched source lithologies suitable for some magmas.

Heavy metal concentrations in soils and tea plants in Sürmene and Çayeli area (NE -Turkey)

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The study area covers two geologically different regions which have intensively been carpeted by tea plants in the Eastern Black Sea. The rocks exposed in the region contain considerable amount of trace matals due to Upper Cretaceous massive sulfide formations and Tertiary epithermal mineralizations. Tea plants grow over the soils derived from such mineralized rocks indicate different concentration in Cu, Pb, Zn, Fe, Cd, P, Al, Na, K, S. Most of the analyzed elements except Al shows higher content ratios in basaltic and sedimentary ocks. Al content is found to be high only in tea plants grow on the dasitic rocks.

The highest average Cu values (26.17 ppm) occur in tea plants in Çayeli area. Pb reaches the highest value in Çayeli (1.94 ppm) in tea plants. The highest Cu, Pb, Zn concentrations were recorded in soils at Sürmene area wheras the highest Al (7.56 %) concentration was observed in Çayeli. The soils in Sürmene area sampled during first sprout period of tea plants contain relatively high amount of Cu.

In order to better understand the element distribution processes in tea plants, some experimental studies were undertaken. Young tea plants were planted in small boxes and were applied with Cu, Zn, Cd and Mn element coplexes and fertilizes. The effect of fertilizers in element mobility was found to be significant. Especially Amonium sulfate fertilizer increased element uptake of tea plants by lovery pH. Bioavailability coefficents of the applied elements are as follows, Cu: 0.14, Zn: 0.18, Cd: 2.45 and Mn: 0.15. The differences in the amounth of irrigation played an important role in bioavailability and uptake of elements both in soil and tea plants. Cu, Zn, and Mn are relatively easily uptaken by the tea plants from the soils often watered. The amount of water has no effect on Cd uptake.

The Pb concentration sharply decrease from road side (1.08 ppm) to 100 m in land (0.37 ppm).