The effect of subduction on the sulfur, carbon, and redox budget of lithospheric mantle

EVANS, K. A.[1] AND POWELL, R.

[1]Dept. Applied Geology, Curtin University, GPO Box U1987, Bentley, WA 6845, Australia: k.evans@curtin.edu.au

[2]School of Earth Sciences, The University of Melbourne, Vic 3010, Australia

Subduction of hydrated lithospheric mantle introduces H_2O, ferric iron, oxidised carbon and sulfur to the subduction zone system. The fate of these components is poorly known but is intimately linked to the global geochemical cycles of iron, carbon and sulfur, the genesis of arc-related ore deposits, the temporal evolution of mantle redox state and subduction-related earthquakes and magmatism. THERMOCALC is used to provide first order constraints on the effect of subduction zone metamorphism on metamorphic redistribution of iron, carbon, sulfur and water in ultramafic rocks via construction of *PT* and *T-X*(O) pseudosections with open system calculation of the effect of fluid loss.

The calculations replicate observed mineral assemblages in high pressure-low temperature ultramafic rocks at *PT* conditions consistent with those suggested by other workers. The results are consistent with open system fluid loss without significant fluid infiltration. Water loss is complete by 850 degrees C, the corresponding depth of fluid loss being consistent with that inferred for earthquakes in subducting slabs. Losses of carbon and sulfur are relatively minor, at around <5% and <1% respectively, so it is envisaged that most carbon and sulfur subducted in ultramafic lithologies is transported to > 5 GPa, below the depths of the source zone for arc volcanoes.

Oxygen activity for rocks in closed systems that evolve with a fixed redox budget is calculated to change from ΔFMQ -1 at 350 degrees C to over ΔFMQ +3 at 850 degrees C. This result emphasises the need to consider redox budget as well as oxygen activity when the results of experiments performed at fixed oxygen activity relative to some buffer are interpreted in the context of natural systems. In open systems, devolatilisation is calculated to increase the redox budget and oxygen activity of the residue via loss of methane and H_2S at the brucite-out and serpentine-out reactions respectively. No fluid-induced mechanism for oxidation of sub-arc mantle by transfer of redox budget from hydrated ultramafic lithologies to the overlying sub-arc mantle was identified, though further thermodynamic data on fluid species such as S_3^- are required to confirm this.