Combustion carbonaceous particles: Evolution of their impacts

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Combustion using either fossil or vegetation fuels both emit a complex array of particles. The resulting aerosol contains primarily polymeric substances which properties substantially vary with the nature of fuels and combustion conditions. Hence, inventories firstly distinguish fossil fuel and "biomass burning" emissions, but furthermore domestic versus industrial or traditional versus modern usages. Future evolutions expected in emerging countries are likely to influence the local and regional impact of particles on atmospheric balances and population health.

Combustion particles have been traditionally described by their BC/OC content a key parameter allowing a minima assessments of their different impacts. More or less recent works, however, let suggest that carbon aerosol chemical complexity must be traced by other proxies among which the prominence of humic-like substances (HULIS) is now recognized. Interplays between HULIS contents and carbon particle radiative properties ("brown carbon"...) and water solubility ("WSOC" content) have to be investigated. In this context, aerosol partitioning into BC and OC and the lack of analytical agreement might be also revisited.

Petrologic preconditioning: A predisposition to polymetamorphism?

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Attainment of high or ultra-high temperatures (HT/UHT) in thickened continental crust requires significant heat input or generation, with a major thermal barrier being the latent heat requirement for melting. Melting or melt crystallization can thus buffer temperature on a local to regional scale [e.g. 1], with an additional (though far smaller) effect associated with sub-solidus dehydration reactions [2]. Incomplete retrogression of many amphibolite and granulite facies rocks implies that fluid influx during cooling is less pervasive than loss during heating [e.g. 2], so that these rocks effectively represent 'partially depleted residua'.

Subsequent heating (M_2) of previously metamorphosed (M_1) rocks requires less energy associated with melting if melt extraction during M_1 significantly reduced the rock's melt fertility. Thermodynamic calculations suggest that if a rock experienced significant melt loss at 850 °C in M_1, the energy required to re-heat that rock to 800 °C during M_2 (calculated as the difference in specific enthalpy from 400 to 800 °C) may be > 15 % less than required without the prior metamorphism. The extent of this energy difference is a function of (i) the pre-M_1 melt fertility, (ii) the efficiency of melt and H_2O loss during M_1 and (iii) the specific *P-T* histories involved. Furthermore, substantially different results are obtained by considering isochemical or progressviely fluid + melt-depleting thermodynamic systems.

A consequence of this 'preconditioning' is that large granulite facies terranes can require substantially less energy to reach upper-amphibolite grade conditions than previously unmetamorphosed equivalents. This effectively pre-disposes them to high-grade metamorphism in later orogenic events (if they are not pervasively rehydrated in an intermediate step). Recognition of this polymetamorphism is difficult if $T_{M1} > T_{M2}$ because little M_2 mineral growth is expected, but resetting of mineral compositions and compositional zoning might be expected. 'Cryptic' polymetamorphism is thus unsurprising in many cases. Furthermore, the presence of large preconditioned bodies can strongly influence the apparent thermal evolution of orogenic belts, substantially modifying both conduction and fluid flow pathways.

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