

Iron speciation in natural and industrial dust: What can we learn from individual particle analysis?

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Iron (Fe) is considered as a main biolimiting micronutrient, whose the bioavailability controls the marine productivity in HNLC zones, then the global carbon cycle. But the extent to which human activities impact the transport of bioavailable Fe to the oceans remains a fundamental question [1]. Many recent works have demonstrated that Fe-bearing aerosols may have variable aqueous solubility, then bioavailability, related to Fe chemical speciation. More particularly, the solubility of Fe-bearing particles increases significantly, with the ferrous (FeII) content of those. The Fe-speciation in dust can be studied by transmission electron microscopy (TEM) [2], coupled with electron energy loss spectroscopy (EELS) [3]. While the TEM-EELS technique has a lower energy resolution than other techniques recently used to investigate the red-ox speciation of Fe in aerosols, such as synchrotron based X-Ray spectroscopies [4], the implementation of TEM-EELS analyses is fast and inexpensive, by comparison to synchrotron techniques and provides relevant results in term of Fe speciation with the advantage of an high spatial resolution, at the particle scale.

We present here results obtained both on desert dust collected in Senegal during the AMMA campaign and on industrial dust (Fe-Mn metallurgy plant) collected in the North of France (Dunkirk harbor). In desert dust, Fe can be present as substitution Fe in the crystalline matrix of aluminosilicate, but the existence of Fe oxide nano-inclusions has also been highlighted at the particle scale, with variable oxidation states. In alloy-making emission plumes, Fe-bearing dusts are mostly emitted from the tapping area of the electric arc furnace and Fe shows an intermediate oxidation state, at the particle scale, with an average of 2.7 ± 0.2 . It appears that, in a general manner, the iron in the smallest particles is more oxidized than in the coarser ones.

[1] Mahowald *et al* (2009) *Annu Rev Mar Sci* **1**, 245-278. [2] Gieré *et al* (2006) *Environ Sci Technol* **40**, 6235-6240. [3] Deboudt *et al* (2012) *J Geophys Res-Atmos* **117**, D12307. [4] Oakes *et al* (2012) *Atmos Chem Phys* **12**, 745-756.

Deep subduction of hot young oceanic slab required by the Syros eclogites

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The Cycladic islands of Syros and Siphnos, Aegean Sea, Greece, represent subducted IAT and BABB remnants of the Neotethyan Pindos Ocean that formed during rifting of the southern active margin of Laurussia (Pelagonia) in the mid-Triassic, in response to northward subduction of Palaeotethys. Garnet porphyroblasts ($\varnothing=1\text{mm}$) in a glaucophane-zoisite eclogite from Kini locality on Syros are compositionally zoned and display a unique prograde heating path from a high-pressure greenschist-facies core with high X_{Sps} and low Mg\# via a blueschist-facies mantle with moderate X_{Sps} and Mg\# to an eclogite-facies rim with low X_{Sps} and high Mg\# . The outermost 35 μm of the garnet rims show flat X_{Sps} with rapidly increasing outwards Mg\# . Na-Act-Chl-Ph rimmed by Gln mark the greenschist-blueschist facies transition, whereas Pg rimmed by Omp and the incoming of Rt at the expense of Ttn signify the blueschist-eclogite facies transition.

Raman barometry of quartz inclusions in the eclogitic garnet rims coupled with elastic modelling of the garnet host [1], and Zr-in-Rt and Grt-Cpx-Ph thermobarometry revealed near-UHP P-T conditions of the order of 2.6 GPa/660°C. By contrast, the greenschist-blueschist transition lies at ~ 0.75 GPa/355°C.

Our new P-T estimates match published T distributions on the slab surface calculated for a subduction velocity of 3 cm/yr, a subduction angle of 30° and an age of incoming lithosphere of ~ 20 Ma with a shear stress of 80 MPa at the slab-mantle interface [2]. The above are in excellent agreement with published isotopic work on zircons and garnets from Syros eclogites suggesting crystallisation from magmas derived from a depleted mantle at ~ 80 Ma and constraining the event of eclogitic metamorphism at ~ 55 Ma. Diffusion modelling of the garnet outermost rims suggests a brief heating pulse of only $\sim 1,000$ years at peak T.

[1] Van der Molen (1981) *Tectonophysics* **73**, 323-342. [2] Peacock (1993) *Geol. Soc. Am. Bull.* **105**, 684-694.