

Low-Ca pyroxene relics in drilled basalts from EPR crust (IODP Site 1256D)

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It is well-accepted that under fast-spreading ridges the differentiation of primitive MORB into the upper volcanic, and the lower plutonic crust proceeds in crustal magma chambers. Thus, it is to expect that those phases which are fractionated in the magma chamber should also be found as phenocrysts in the erupting melts, at least from time to time. This is general valid for olivine, plagioclase, and clinopyroxene, but not for orthopyroxene. This is expressed in the "orthopyroxene paradoxon" meaning that orthopyroxene is often present in the gabbroic rocks of the plutonic crust from fast-spreading ridges (e.g., from Hess Deep and Garrett Transform fault), but not in the corresponding basalts of the upper crust.

We studied basalts and gabbros from the IODP (Integrated Ocean Drilling Program) Site 1256D in the eastern Pacific where 15 Ma old crust was formed at the EPR (East Pacific Rise) under superfast conditions (Wilson et al., 2006). Here, the Expeditions 309 and 312 deepened Hole 1256D initiated by Leg 206, drilling through lavas, the underlying sheeted dike complex, and into gabbroic rocks, providing the first penetration of the dike-gabbro boundary in intact ocean crust. Many of the gabbros bear orthopyroxene both as poikilitic and as prismatic crystals implying that orthopyroxene saturation was reached during differentiation. However, up to now, orthopyroxene was not recorded as phenocryst or matrix mineral in the corresponding dikes, sheet flows and pillow basalts above the gabbro/dike transition. Therefore, the first observation of low-Ca pyroxene in the volcanic section of the 1256D drill core is of significance.

Low-Ca pyroxene was detected as relics in matrix clinopyroxenes in several samples from the uppermost sheet flows of Leg 206. They appear as strongly disrupted, often cloudy patches in intensely zoned matrix clinopyroxenes. Since they show relatively high CaO contents (4-5 wt%), these pyroxenes correspond in composition to typical pigeonites. Their Mg# ($\text{MgO}/(\text{MgO}+\text{FeO}) \cdot 100$; molar) vary between 75 and 82, and are generally slightly higher compared with the rimming matrix clinopyroxene. This implies that the magma which generated the low-Ca pyroxene was more primitive than the later one producing the matrix clinopyroxene, which contrasts with the general observation that orthopyroxene is more stabilized in evolved MORB systems than in primitive (at shallow pressures). The textural features of the low-Ca pyroxenes suggest that partial melting reactions proceeded instead of simple resorption by a later magma.

References

Wilson D.S. et al., (2006), *Science* **312**, 1016-1020.

Individual particle analysis of urban aerosols in the Rhein-Main area

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Epidemiological studies have shown a correlation between aerosol concentration in the ambient air and mortality. Adverse health effects seem to be better correlated with the surface or the number as with the mass of aerosol particles inhaled. Therefore individual particle analysis techniques provide very valuable additional information to the conventional performed mass concentration measurements (Pm_{10}).

In the years 2003 and 2004, size-resolved aerosol particle samples in the size range 0.1 – 10 μm aerodynamic diameter were collected at an urban background station in Mainz, Germany. Size, morphology, chemical composition and mixing state of more than 5400 individual particles of seven selected sampling days were analyzed in detail by scanning electron microscopy and energy-dispersive X-ray microanalysis. In addition, transmission electron microscopy, aerosol mass spectrometry and atomic force microscopy were applied to obtain further information about the mixing state of the particles. The fine particle fraction (diameter < 1 μm) is always dominated by complex secondary aerosol particles ($\geq 90\%$ by number) independent from air mass origin. These particles are complex internal mixtures of ammonium and sodium sulfates, nitrates, and organic material. Between 20 and 40% of the complex secondary aerosol particles contain soot inclusions. The composition of the coarse particle fraction (> 1 μm diameter) is strongly dependant on air mass history with highly variable abundances of complex secondary aerosol particles, aged sea-salt, silicates, silicate-mixtures, calcium sulfates, calcium sulfate/carbonate mixtures, calcium nitrate/carbonate mixtures, biological particles, and external soot.

The dominance of complex secondary aerosol particles shows that reduction of the precursor gases has to be a major goal for successful reduction strategies for PM₁₀. Additionally, because of the carcinogenic potential and the frequent occurrence of soot inclusions within secondary aerosol particles, the reduction of the soot component has to be an important goal.