

Carbonate and halide inclusions in diamond and deep-seated carbonatitic magma

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A series of uncommon micro- and nano-inclusions was identified in diamonds from the Juina area: carbonates, halides, and others. Carbonates are typically represented by calcite (with Sr and Ba), K-rich nyerereite $\text{Na}_2\text{Ca}(\text{CO}_3)_2$ with an admixture of K_2O (10.0-13.78 wt. %), and nahcolite $(\text{Na,K})\text{HCO}_3$. Halides are NaCl , KCl , CaCl_2 and PbCl_2 . Minerals of the periclase-wüstite series embedded in a carbonatous matrix belong to two separate groups: wüstite and Mg-wüstite with $\text{Mg}\# = 1.9\text{-}15.3$, and Fe-periclase and periclase with $\text{Mg}\# = 84.9\text{-}92.1$. Wollastonite-II (high), with $\text{Ca}:\text{Si} = 0.992$ has a triclinic structure. Ca-rich garnet has a noticeable admixture of Zr; it belongs to the andradite – kimzeyite – schorlomite group. Some apatite grains are enriched in La, Ce and Nd. Besides these minerals, there are, among inclusions in diamond, anhydrite, cuspidine, phlogopite, and others. All inclusions are polymineralic solid inclusions. These minerals form a carbonatitic-type mineral association in diamond which, according to their paragenetic associations, may have been formed in the lower mantle and/or transition zone. Wüstite inclusions with $\text{Mg}\# = 1.9\text{-}3.4$, according to experimental data, may have been formed in the lowermost mantle.

The source for the observed carbonatitic-type mineral association in diamond is deep-seated carbonatitic magma. Genetically, it may be of two types: juvenile, rich in volatiles, such as Cl, F, and H, which played important role in formation of diamond; this type associates with typical lower-mantle diamonds (low-nitrogen, high nitrogen aggregation, isotopically heavy type-II diamonds); and low-degree partial melt from subducted, carbonated oceanic crust, which produces trace-element-rich carbonatite melts, associated with isotopically-light ‘subduction-type’ diamonds. There may be a variety of compositions of deep-seated carbonatitic magmas. Associations with pure calcite may be products of calcitic-carbonatitic magma, while the nyerereite- and nahcolite-containing associations, particularly with halides may be products of natrocarbonatitic magma. The data on melt inclusions in diamond and experimental data on the existence of carbonate-silicate melt and chloride-carbonate brine suggest a polygenetic nature of deep-seated carbonatitic magmas.

Hygroscopicity of Tropospheric Aerosols: One year of measurements at Jungfraujoch (3580 m asl.)

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Aerosol particles are able to absorb water at high relative humidity (RH). The hygroscopic growth factor (GF) is defined as the ratio of the particle diameter at humidified and dry conditions. Particles that have grown to larger diameters due to water uptake scatter the incident sunlight to a greater extent, and are more likely to act as cloud condensation nuclei [1]. Aerosols therefore can strongly influence the radiation budget of the earth.

The aerosol at the high alpine research station Jungfraujoch (3580 m asl.) is representative of the aerosol found in the lower free troposphere. In summer, diurnal variations are found in most aerosol variables due to the injection of the planetary boundary layer (PBL) air [2]. Here we present the first extended data set comprising hygroscopicity measurements of different particle dry sizes (D_0), lasting from Mai 2008 to April 2009.

Preliminary results confirm that in summer diurnal variations of the GF are found with minima at night ($\text{GF} \sim 1.45$) for particles with $D_0 = 265$ nm during the selected period (Figure 1). In the afternoon, GFs up to $\text{GF} \sim 1.62$ are found for this size class, giving evidence to the site being influenced by injection of PBL air. Smaller particles show a similar behaviour while GFs are in general lower.

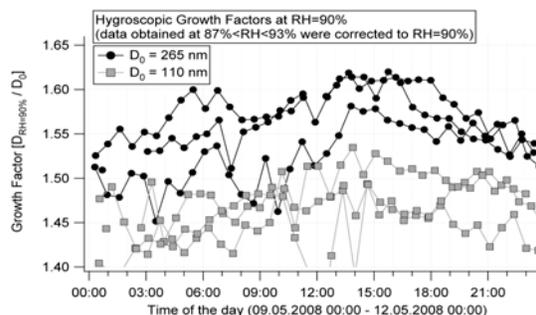


Figure 1: Diurnal variations of the hygroscopic growth factors of two particle dry sizes measured at 90% RH.

[1] IPCC (2007) *Climate Change 2007: The Physical Science Basis*. Cambridge, U.K.: Cambridge University Press. [2] Sjogren, S., et al. (2008). *Atmos. Chem. Phys.*, 8(18) 5715-5729.