# Identification of Transport Pathway and Geographical Source Location of Light Absorbing Species and Co-Pollutants

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Ground observations of light absorption and aerosol-borne species are analysed and digested in a hybrid receptor-modelling framework called the Potential Source Contribution Function (PSCF)[1]. The analytic method establishes the relevant events based on observations using a number of time-series techniques to separate various frequency components; then the PSCF algorithm computes the probability of the overloading probability of identifiable polluting events for each grid cell in the modelling domain. The calculated probability is then an indication of a grid cell being an emission source of a particular pollutant under investigation. Multiple pollutants and or co-pollutants are used in the combined / joint probability analysis to enhance the identification power. We have analyzed the assembled time-series observations made at Barrow, Alaska for the past 15 years. Similar to many previous data taken at other site such as Alert, NWT, periodic pattern of light absorption, CNC, and other ground aerosol species concentrations were observed. Many data from Barrow are ran off by low-freqency compoent in the timer-series analysis. For those detectable, the correlation between light absorption and black carbon measurements were analyzed to show that there are other light absorption components existing in the Arctic particles. Backward trajectories segregated by season show different transport pathways to the two receptor sites suggesting alternative control strategies. Ongoing PSCF modeling will identify the geographical locations of various pollutants modeled and show the uncertainty of the identification, which will be presented in the conference.

*[1] Cheng, M.D., Schroeder, W.H., 2000. J. Atmos. Chem. 35, 101-107.*

# Diffusion in Minerals Relevant to Geochronology

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Understanding diffusion processes in minerals of geochronologic interest is important in interpreting results from geochronological studies and in refinement of thermal histories. Much progress has been made in characterizing diffusion in various systems, and work continues. Diffusivities in minerals may depend on many factors, including the presence of fluids. There is abundant evidence [1] that the presence of water or other hydrous species affects oxygen diffusion in minerals. However, studies of cation diffusion generally indicate little influence of the presence of hydrous species. Hence, while fluids can play a significant role in geochronological systems in facilitating dissolution/precipitation reactions which can result in the resetting of isotopic and chemical signatures, it appears that fluids will have little additional effect on resetting due to volume diffusion within mineral grains at crustal conditions. A summary of relevant diffusion studies will be presented, along with implications of these findings with regard to transport in fluid-present systems.

Diffusion data have long found application in geochronologic studies through the concept of diffusive closure advanced by Dodson [2] and its subsequent refinements [e.g., 3,4]. When considering geologic temperature-time paths, the most important limitation of Dodson's [2] expressions is that they apply strictly to cooling regimes, since many geological processes involve heating of mineral grains that are initially diffusively closed. Thus, in a prograde thermal regime, it is not a question of when closure "sets in" but when a mineral grain "opens up" diffusively. Despite its original intent, Dodson's equation has been used frequently to address closure conditions of minerals during heating, perhaps because simple alternatives are lacking. Sophisticated approaches have been developed to address diffusive loss during heating, but mainly for specific applications; however, Gardes and Montel [5] have recently more generally examined conditions for "opening" and "resetting" in prograde temperature regimes.

In a complementary study, we take a somewhat different approach, using a combination of numerical simulations and mathematics to obtain simple equations with parameters equivalent to those in used in Dodson's equation [2], to evaluate conditions for opening and resetting in prograde T-t regimes. Tests of these equations demonstrate accuracy to within 5°C for the vast majority of measured diffusivities, and within 1° in most cases. In addition, there are essentially no restrictions on grain size or heating rate (up to 2000°C/Myr) that can be used without loss of accuracy. These findings will be presented, with discussion of various parameters considered in the modelling, including linear heating vs. other prograde paths, and the production of radiogenic species.

[1] Farver (2010) *Rev. Mineral. Geochem.* **72**, 447-507. [2] Dodson (1973) *CMP* **40**, 259-274. [3] Dodson (1986) *Mat. Sci. Forum* **7**, 145-154. [4] Ganguly & Tirone (1999) *EPSL* **170**, 131–140. [5] Gardes & Montel (2009) *CMP* **158**, 185–195.