Natural high-temperature metamorphic calcite as compositionally homogenous microanalytical standard?

WOLFGANG MÜLLER[1], JOHN W. VALLEY[2], VIOLA WARTER[1], REINHARD KOZDON[2], DAVID EVANS[3] AND IAN J. ORLAND[2]

[1]Royal Holloway University of London, Egham, U.K. (w.muller@es.rhul.ac.uk)
[2]University of Wisconsin, Madison WI, USA
[3]Yale University, New Haven, CT, USA

Spatially-resolved compositional analysis of inorganic and biogenic carbonates represents a mainstay of LA-ICPMS or SIMS investigations with a myriad of applications. However, natural or artificial carbonate minerals that are compositionally, rather than isotopically, homogenous at both few percent level and <10s of micrometer-scale, as well as available in sufficient quantities, have remained elusive. Thus alternative materials such as pressed-powder pellets (conventional [1] or from nanometer-sized particles [2] [3]) are used as primary or secondary standards.

High(est)-temperature metamorphic processes (e.g. granulite facies) represent an alternative mechanism by which homogenous materials may be produced [4]. Such minerals are used as isotopic standards in e.g. SIMS analysis [5].

Using LA-ICPMS [6], we present initial results of an assessment of the intra- and inter-grain elemental-compositional variability of several tens of randomly chosen, mm-sized grains of UWC-3 (95AK24), a SIMS $\delta^{18}O$ & $\delta^{13}C$ standard [5]. Initial track and depth profile data of ~40 elements (alkali, alkaline earth, transition metals, HFSE, REE, actinides etc.) reveal not only suitable concentrations similar to many low-T carbonates, but more importantly remarkable intra and inter-grain homogeneities, in many cases on-par with NIST61x glasses (e.g. Mn, Mg, Fe, Sr Y, Ce: 1-4% (1 RSD)). Calcites from another, broadly similar granulite-facies marble specimen, however, are compositionally heterogeneous with indications of later recrystallization, indicating that only exceptional sample preservation may yield suitable calcites. Since such samples principally occur in sizable quantities, it is hoped that following further extensive characterization, such calcite may become a much-needed carbonate (trace) element microanalytical standard.

[1] Wilson SA et al (2008) *GCA* **72**: A1025. [2] Tabersky D et al (2014)*: JAAS* **29**: 955-962. [3] Garbe-Schönberg D & Müller S (2014) *JAAS* **29**: 990-1000. [4] Edwards KJ & Valley JW (1998) *GCA* **62**: 2265-2277. [5] Kozdon R et al (2009) *Chem Geol* **258** 327-337. [6] Müller W et al (2009) *JAAS* **24**: 209-214.