JRAS-06: Keeping up with changing internationally-distributed, light-element stable isotopic reference materials

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One of the most critical aspects of measuring carbon isotopic signatures of atmospheric CO_2 is the stringent standardisation procedure which is required. Without it, inter-laboratory $\delta^{13}C$ comparisons of atmospheric CO_2 are difficult at best, and impossible at worst. Following the "principle of identical treatment" (IT principle; Werner and Brand, 2001), isotopic reference materials for atmospheric CO_2 analysis should be chemically identical to analysed samples. For the last 10 years, the stable isotope laboratory at the Max-Planck-Institute for Biogeochemistry (BGC-IsoLab) has offered the Jena Reference Air Set (JRAS-06) to the scientific community. CO_2 for this set of reference materials is evolved from carbonates, including NBS 19 calcite ($\delta^{13}C \equiv +1.95$ mUr and $\delta^{18}O \equiv -2.2$ mUr) that anchors one end of the VPDB-LSVEC carbon-isotope scale and LSVEC lithium carbonate ($\delta^{13}C \equiv -46.6$ mUr), and it is diluted into CO_2-free matrix air. Thus, an air-CO_2 scale has been produced that is linked directly to the VPDB-$CO_{2(gas)}$ scale. Use of JRAS-06 enables laboratories to follow the identical treatment principle and report their findings on the VPDB-$CO_{2(gas)}$ scale.

The year 2016 was a turbulent year for the VPDB oxygen-isotope scale and the VPDB-LSVEC carbon-isotope scale. The distribution of NBS 19 was discontinued because its supply was nearly exhausted. A new calcite, IAEA-603 (Carrara marble; https://nucleus.iaea.org/rpst/referenceproducts/referencematerials/Stable_Isotopes/13C18and7Li/IAEA-603/index.htm; $\delta^{13}C = +2.46 \pm 0.01$ mUr and $\delta^{18}O = -2.37 \pm 0.04$ mUr) was introduced by the International Atomic Energy Agency as an internationally-distributed, secondary isotopic reference material to anchor measurement results to the carbon- and oxygen-isotope scales. Furthermore, LSVEC was deemed inappropriate as a second scale anchor because it can react with atmospheric CO_2, thereby affecting its carbon isotopic signature. BGC-IsoLab is currently involved in a collaborative effort to quantify the $\delta^{13}C$ value of a high purity calcium carbonate with a $\delta^{13}C$ value of ~–42 mUr that is intended to serve as an internationally-distributed, secondary isotopic reference material to anchor measurement results to the VPDB-LSVEC carbon-isotope scale. This new material also can be used to anchor the JRAS-06 scale. Here, we present preliminary results on this new high purity calcium carbonate whose $\delta^{13}C$ value does not change with exposure to atmospheric CO_2. Additionally, we discuss some considerations that need to be made when determining isotope-delta values of secondary isotopic reference materials.