

# Grain-scale stable carbon and oxygen isotopic variations of the international reference materials IAEA-603 (newly released) and NBS 19

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The international reference material IAEA-603 prepared from Carrara marble (calcite) was newly released on 2016 to replace the reference material NBS19 (exhausted). From the reference sheet of IAEA-603 (Fajgelj and Assonov, 2016), assigned carbon and oxygen isotopic ( $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$ ) values are  $+2.46 \pm 0.01\%$  and  $-2.37 \pm 0.04\%$ , respectively at a sample size of about 120  $\mu\text{g}$ . For sub-microgram scale isotopic analysis, we examined the grain-scale stable carbon and oxygen isotopic variations of IAEA-603. The individual grains of IAEA-603 (grain size: 200 to 760  $\mu\text{m}$ ) were measured with an IsoPrime100 isotope ratio mass spectrometer with customized continuous-flow gas preparation system (MICAL3c, Ishimura et al., 2004, 2008) at National Institute of Technology, Ibaraki College, Japan, and the individual weight of each grain estimated from the reacted  $\text{CO}_2$  gas volume was 4-90  $\mu\text{g}$ . The standard deviations ( $1\sigma$  uncertainties) of  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  of the individual grains of IAEA-603 are  $\pm 0.07\%$  and  $\pm 0.16\%$ , respectively ( $N = 16$ ), and the grain-scale analytical results also indicated homogeneous values as same as stable isotopes of the single grains of NBS19 (the standard deviation:  $\pm 0.10\%$  in  $\delta^{13}\text{C}$ ,  $\pm 0.16\%$  in  $\delta^{18}\text{O}$ ,  $N = 16$ , Ishimura et al., 2008). In IAEA-603,  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  ranged within 0.2‰ and 0.4‰, respectively. Both  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  of the individual grains showed non-significant grain-size dependencies. From the scanning electron microscope observations, the individual grains of IAEA-603 were dominantly polycrystalline with translucent grains composed of coarse crystals, and contained a certain amount of white opaque grains containing fine crystals. On the other hand, NBS19 showed single-crystal-like grains. Thus, as the reference sheet of IAEA-603 (Fajgelj and Assonov, 2016) mentioned, the storage in sealed ampules is important for avoiding exchange with atmospheric moisture and atmospheric  $\text{CO}_2$ , especially in polycrystalline IAEA-603.

Keywords: stable isotopes, international reference material, carbonate, IAEA-603, SEM